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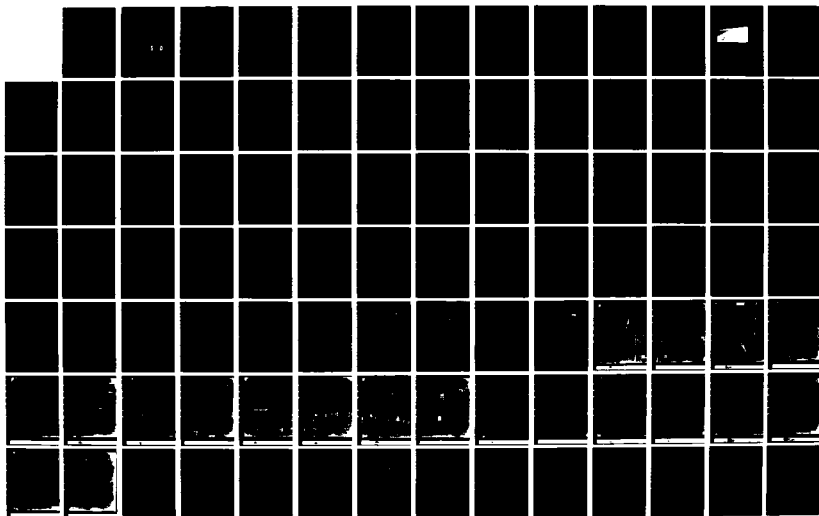
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
CLEVELAND BROOK RESER. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUN 79

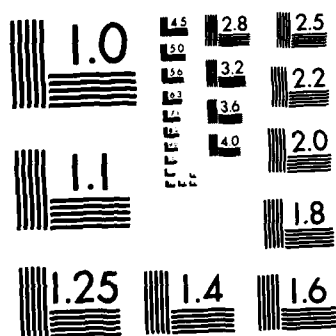
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HOUSATONIC RIVER BASIN
HINSDALE, MASSACHUSETTS

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CLEVELAND BROOK RESERVOIR DAM
MA 00225

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Cleveland Brook Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Housatonic River Basin Cleveland Brook Hinsdale, Massachusetts		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The facility at Cleveland Brook Reservoir includes a 1,650 foot long earth dam approximately 71 feet high and 1140 feet of earth dikes, including a 80 foot long concrete spillway. The dam is considered to be in fair condition. It is classified as being intermediate in size and high in potential hazard. Investigations are recommended to determine the significance of the seepage.		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
174 HUNTER DRIVE
WALTHAM, MASSACHUSETTS 02154

NEDEP

OCT 11 1979

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Enclosed is a copy of the Cleveland Brook Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, City of Pittsfield, City Hall, Pittsfield, Massachusetts 01202.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

M. B. Scheider

MEX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Inc 1
AS 5-10-1

CLEVELAND BROOK RESERVOIR
MA 00225

HOUSATONIC RIVER BASIN
HINSDALE, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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**PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**

Identification No. : MA 00225
Name of Dam: CLEVELAND BROOK RESERVOIR DAM
Town: HINSDALE
County and State: BERKSHIRE, MA
Stream: CLEVELAND BROOK
Date of Inspection: 1 MAY 1979

BRIEF ASSESSMENT

The facility at Cleveland Brook Reservoir includes a 1,650 foot long earth dam approximately 71 feet high and 1140 feet of earth dikes, including a 80 foot long concrete spillway. Dike A is approximately 17 feet high and is perpendicular to the dam's right abutment. The earth embankments on each side of the concrete spillway, which are located approximately 1700 feet southeast of Dike A, are known as Dike B and Dike C. A portion of the crest of Dike B is depressed for 135 feet in length to form an overflow spillway. The crest elevation of the remaining portion of Dike B and all of Dike C is 1 foot lower than both the main dam and Dike A. Intakes are present at the gatehouse on the main dam for water supply to the City of Pittsfield. A reservoir drain is present beneath the main dam, but this structure has not been maintained. A blowoff pipe from the 30-in. water transmission main presently serves as a reservoir drain. The facility was originally constructed in 1949 to provide water to the City of Pittsfield. The dam was raised in height a total of 5 feet in 1963.

The dam is considered in fair condition due to observed seepage at the main dam, as well as at Dikes B and C. A 1977 report by the firm of Metcalf and Eddy is available on the seepage observed at the right abutment of the main dam. No prior investigations are known of the seepage at other locations.

Based on the size classification, intermediate, and hazard classification, high, in accordance with Corps of Engineers Guidelines, the spillway test flood is the Probable Maximum Flood (PMF). Hydraulic analysis indicates that the spillways can pass the routed test flood outflow of 2,200 cfs with approximately 0.65 feet of freeboard remaining with respect to Dikes B and C. The combined discharge capacity of both the main and overflow spillways was estimated to be 6,480 cfs with the water surface at the top of dam.

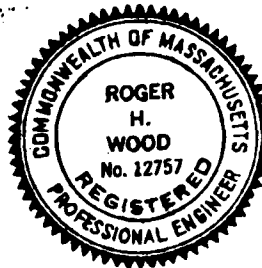
Investigations are recommended to determine the significance of the seepage observed along the toe of the main dam and downstream from Dikes B and C and to continue the monitoring of the piezometers and implement remedial measures for control of the seepage at the right abutment of the main dam. Remedial measures recommended for this facility include the continued mowing of slopes, the filling of animal burrows, the repair of the

protective casing at piezometer B-4, the removal of weed growth from spillway concrete joints, removal of debris from spillway apron, repair of deteriorated concrete at the reservoir drain, the clearing of debris from the invert of the reservoir drain, the cleaning and painting of the reservoir drain flap valve, the placing of stones at the end of the access bridge to the gatehouse, the removal of soil and vegetation from the top of the blowoff structure and the cleaning of the blowoff structure outlet channel. The Owner should develop a formal maintenance program, operational procedure, emergency preparedness plan, and institute a program of annual technical inspections. The remedial measures and recommendations should be performed within one year of receipt of this report by the Owner.

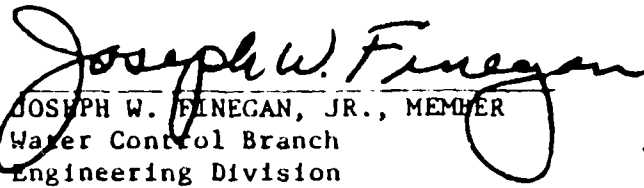
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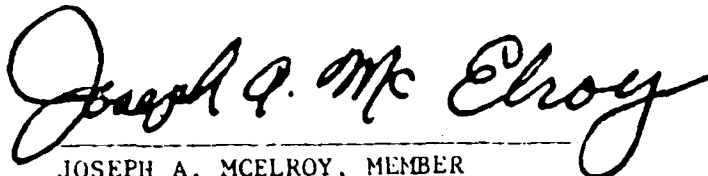
Roger H. Wood

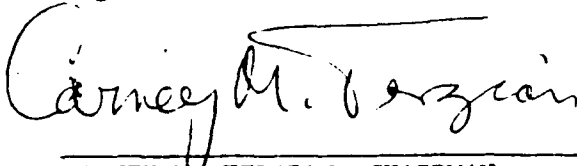
Roger H. Wood
Vice President



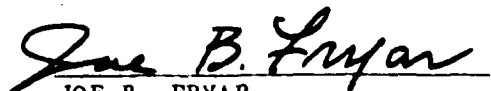
This Phase I Inspection Report on Cleveland Brook Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.


JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division


JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division


CARNEY M. TERZIAN, CHAIRMAN
Chief, Structural Section
Design Branch
Engineering Division

APPROVAL RECOMMENDED:


JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm runoff), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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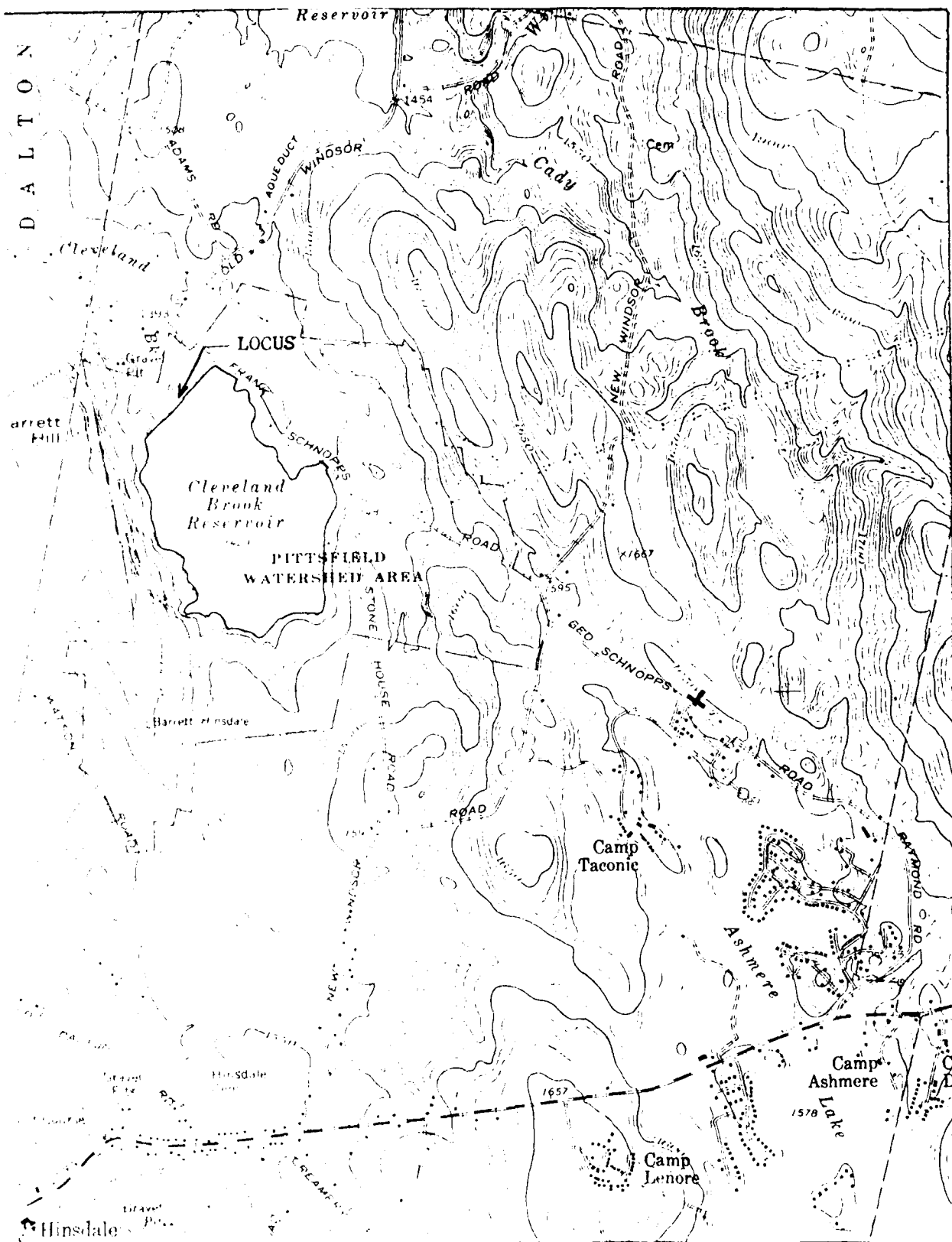
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1. OVERVIEW OF DAM FROM RIGHT ABUTMENT.



NAME: CLEVELAND BROOK RESERVOIR

IDENTIFICATION NO.: MA 00225



LOCATION MAP
USGS QUADRANGLE

PERU, MASS

APPROX. SCALE: 1" = 2000'

The gatehouse, spillway, reservoir drain structure and blowoff structure are in generally good condition. Minor items requiring attention were present at most of these structures. Seepage was noted around the concrete walls of the spillway and reservoir drain outlet structure. However, the flow at these locations appear to be seepage associated with the dikes and main dam rather than with the structures themselves.

- d. Reservoir Area - The reservoir is surrounded by moderately sloping, heavily forested hills. There is no development within the watershed of the reservoir. There was no observed potential for major slope failure into the reservoir which could result in waves that might overtop the dam or dikes. No conditions were noted which could cause a sudden increase in sediment load into the reservoir. There have been no apparent alterations to the surface of the watershed which could extensively effect the runoff characteristics as they existed during the design of the facility.
- e. Downstream Channel - The channel immediately downstream of the spillway is a flat, grassed waterway flowing to a drop inlet about 50 feet from the spillway. The spillway outflow enters the drop inlet and is carried under Frank Schnopps Brook via two 18-in. culverts. The culvert capacity is normally exceeded during the spring runoff season and the road is frequently overtopped. Beyond Frank Schnopps Road the downstream channel proceeds through an undeveloped swampy area to a culvert under Old Windsor Road before joining Cleveland Brook which originates at the downstream toe of the reservoir's main dam. The main dam is about 2,000 ft upstream of the confluence of Cleveland Brook and Schnopps Brook. Cleveland Brook follows a steep grade through a slightly developed area to a flat area better known as the Wachonah Country Club where it joins the East Branch of the Housatonic River. The Wachonah Regional High School is located in this flat area on the left bank of the river. The channel proceeds to Center Pond, through the middle of the Town of Dalton, and then through a series of mill dams to a gravel pit and railroad yard area on the east side of the City of Pittsfield. It then flows through the City of Pittsfield before joining with the West Branch of the Housatonic River to become the Housatonic River. The Housatonic River meanders through the southeastern portions of Pittsfield before entering the Town of Lenox. There is moderate to high density development along the river banks through the Town of Dalton and the City of Pittsfield.

3.2 Evaluation

The present performance of the main dam and dike embankments appears to be generally satisfactory. However, because of seepage conditions observed at the Main Dam and at Dikes B and C, the overall condition of the project can be considered only fair. No conditions requiring urgent remedial action were observed.

The observed seepage conditions at the Main Dam and at Dikes B and C are not considered serious at this time. However, changes in the quality or pattern of seepage could indicate the development of problems within the embankments.

2. The crest of each dike has a mowed grass cover as shown in Photo No. 19. The crest elevation appears to be up to about 0.5 ft. below the top of the spillway training walls.
3. The downstream slope of the non-overflow portion of Dike B is grass and weed covered. No evidence of sloughing or other instability was noted. The area below the overflow section is broad, flat and mostly grass covered. There are some bare spots and slight rutting on the downstream slope.
4. The downstream face of Dike C has a mowed grass cover. No evidence of sloughing or other instability was observed.
5. Seepage was noted at the toe of Dike B, at the contact with the left spillway training wall as shown in Photo No. 17. Slight flow was evident but no evidence of soil particle movement was discernible. The area below the spillway was wet and soft.
6. Seepage was observed along both sides of the road below Dike C. Slight flow was noted but no evidence of soil particle movement was observed. A portion of this seepage may originate within the right abutment area.

The main spillway shown in Photos 16 and 18 is in very good condition. Some minor weed growth was observed in the concrete joints, minor debris is present on the spillway apron and minor cracking was noted at some of the construction joints. The downstream channel appears to be overgrown with many young trees as shown in Photo 19. However, the growth does not appear to be a significant obstruction to flow at this time.

The intake gatehouse (control tower) as shown in Photos 8 and 9 appears to be in very good condition. The only deficiency noted was that the approach to the service bridge at the dam end is low as shown in Photo 8.

The reservoir drain outlet structure shown in Photo 5 is in fair condition. The base slab contains debris, which may prevent the flap valve from operating. The top of the right concrete wall has started to deteriorate. Moss growth is present at the top of the concrete head wall. The flap valve is rusted. A flow of water was noted to be exiting from behind both side walls. The downstream channel is overgrown with marsh grass and some young trees.

The chamber containing the manually operated blowoff valve downstream of the dam, as shown in Photo 10, was not accessible for inspection. The top slab is covered with leaves, soil and minor vegetation. The outlet pipe from the blowoff shown in Photo 11 has its invert silted in. The outlet channel from the blowoff contains fallen branches.

6. Seepage which apparently exits from the toe drains was noted near the drain outlet structure shown in Photo 5 and in the low area below the gatehouse. Both areas were wet and marshy below the toe, within 50 to 100 ft. of the base of the slope. Flow was evident but no indication of soil profile movement was observed.
7. Seepage was also evident at the embankment contact with the right abutment, at the level of the berm, as shown in Photo 7. Seepage flow at this location was estimated to be approximately 1 to 2 gpm. No evidence of soil particle movement was observed. The seepage condition at this location has been investigated by Metcalf & Eddy. The seepage observed on 1 May 1979 appeared to be similar to the condition described by Metcalf & Eddy in a report dated 28 December 1976. The protective casing at piezometer B-4 is broken.

c. Appurtenant Structures - The condition of the appurtenant structures are as follows:

Dike A appears to be in good condition, based on the visual observations outlined in the following remarks:

1. The visible portion of the upstream face has riprap wave protection consisting of cobbles to 5 ft. pieces, extending to the crest as shown in Photo No. 12. There are a few weeds growing in the riprap. Otherwise, the riprap appears sound and in stable condition.
2. The crest is an asphalt-paved roadway, with grass and weed covered shoulders as shown in Photo No. 13. the pavement appears to be in good condition, except for minor cracking.
3. The downstream slope has a mowed grass and weed cover. No evidence of sloughing, erosion or other instability was observed.
4. There is a wet, soft area downstream of the toe along the right half of the embankment. The wet area is defined by the presence of thick brush and small trees. This wet zone extends downstream about 200 ft. to a swampy area where there is ponded water. No evidence of flow or movement of soil particles was discernible.

The performance of Dikes B and C appears to be generally satisfactory. However, because of the presence of downstream seepage, the overall condition can be considered only fair. The observed conditions at Dikes B and C area are outlined by the following remarks:

1. The visible portion of the upstream face of each dike and the overflow portion of Dike B have riprap wave protection consisting of cobbles to 5 ft. pieces as shown by Photos 14 and 19. There are a few weeds growing in the riprap but generally the stones appear to be sound and in stable arrangement.

SECTION 3: VISUAL INSPECTION

3.1 Findings

- a. General - The Phase I visual examination of Cleveland Brook Reservoir Dam was conducted on 1 May, 1979.

In general, the dam, dikes and spillway can only be considered in fair condition due to observed seepage at various locations. The reservoir level at the time of the site examination was at elevation 1436.9.

Visual inspection checklist for the site visits are included in Appendix A and selected photographs are given in Appendix C.

- b. Dam - Visual observations indicate that the present performance of the Main Dam is, generally, satisfactory. However, because of seepage conditions observed at the right abutment, the overall condition of the dam can be considered only fair. The following remarks outline the observed condition of the Main Dam embankment.
1. The visible portion of the upstream slope has riprap consisting of cobbles to 5-ft. pieces extending to the crest as shown by Photo No. 3. Weeds were noted growing between the stones and a few stones were locally dislodged but generally the riprap appeared to be sound and in a stable arrangement.
 2. The crest has a mowed grass cover and is slightly rutted as shown by Photo No. 2. There may be up to 0.5 ft. variation in crest elevation. The grassed portion of the crest is about 13 to 14 ft. wide.
 3. The downstream slope, as shown in Photo No. 4, has a mowed grass cover with occasional cut weeds and stumps on the lower portion. There is some uncut brush on the rock toe, near the right end. Paved gutters along the berm are overgrown.
 4. Two abandoned animal burrows were noted in the downstream slope. One was located just below the berm, near the gatehouse and one was about 300 ft. left of the gatehouse about 15 ft. below the crest. The latter hole was probed about 7 ft. horizontally into the embankment.
 5. The lower portion of the downstream slope is somewhat irregular and varies an estimated 0.5 to 1.0 ft. from plane. However, no evidence of sloughing or other slope movement was discernible.

SECTION 2: ENGINEERING DATA

- 2.1 Design - Design records for this dam are available at the offices of Metcalf & Eddy, 50 Staniford Street, Boston, Ma. Record drawings of this facility are available at both the offices of Metcalf & Eddy and the Department of Public Works, Pittsfield, Massachusetts. The record drawings contain the subsurface exploration performed at the site prior to construction. Copies of pertinent data on this facility are included in Appendix B of this report.
- 2.2 Construction - Construction reports for this project are located at the offices of Metcalf & Eddy, 50 Staniford Street, Boston, MA.
- 2.3 Operation - No operation records other than the inspection reports on the facility and water level readings at the reservoir were located. The design engineer, Metcalf & Eddy, completed a detailed investigation of seepage occurring near the east abutment of the existing dam and submitted their report in December 1976.
- 2.4 Evaluation
 - a. Availability - Documents described above are available at the offices of Metcalf & Eddy, 50 Staniford Street, Boston, MA. A portion of these documents are on microfilm and require time to be made available. The original plans pertaining to the design and construction of the facility in 1948 are available at the Department of Public Works, Pittsfield, MA. The documents pertaining to the alteration to the dam and appurtenances which were done in 1963 are available at the offices of Metcalf & Eddy.
 - b. Validity - The record drawings for this project were in excellent agreement with the features observed in the field.
 - c. Adequacy - The available data, in combination with the visual inspection described in the following section, is adequate for the purposes of the Phase I investigation.

(8) Cutoff ---Trench filled with "select impervious material"---

(9) Grout Curtain -----None known-----

h. Diversion and Regulating Tunnel -----None

i. Spillways

Main Spillway

(1) Type-----Conc. broad crested weir w/provisions
for flashboards

(2) Length of weir-----80 ft

(3) Crest elevation-----1435 (1437 w/flashboards)

(4) Gates-----None

(5) U/S Channel-----Inv. El. 1425.7 (Level)

(6) D/S Channel-----Stilling basin

Overflow Spillway

(1) Type-----earth embankment with riprap
protection on 16 ft. wide crest

(2) Length of weir-----135 ft.

(3) Crest Elevation-----1439

j. Regulating Outlets - The 30-in. pipe reservoir drain is located at approximately the center of the drain. A reinforced concrete structure is located at the inlet end of the drain. The structure contains an inlet formed of concrete, a sluiceway at the upstream end of the pipe and the gate operator. The operating level for the valve is at elevation 1390 which is below the reservoir water level at the normal pond elevation. The inlet invert elevation is 1372. The reservoir drain discharges at the downstream toe of the dam through a flap valve into a reinforced concrete structure with concrete energy dissipators. The reservoir drain has not been maintained and since the gate operator is below the normal reservoir level, the facility is not considered to be operational. A blowoff pipe from the 30-in. water transmission main located approximately 450 feet from the downstream toe of the dam presently serves as the reservoir drain.

d. Reservoir Length (feet)

- (1) Length of test flood pool-----3550
- (2) Length of Normal pool-----3440
- (3) Length of flood control pool-----N/A

e. Storage (acre-feet)

- (1) Normal pool-----4,928
- (2) Flood control pool-----N/A
- (3) Spillway crest pool with 2-ft of flashboards-----5,230
- (4) Top of dam-----6,022
- (5) Test flood pool-----5,741

f. Reservoir Surface (acres)

- (1) Normal pool-----151
- (2) Flood-control pool-----N/A
- (3) Spillway crest with 2-ft of flashboards-----153
- (4) Test flood pool-----157
- (5) Top of dam-----162

g. Embankments

	<u>Dam</u>	<u>Dike A</u>	<u>Dikes B & C</u>
(1) Type	-----Earth embankment-----		
(2) Length	1650 ft	690 ft	415 ft
(3) Height	71 ft max	17 ft max	11 ft max
(4) Top width & elev.	17.5 ft at elev. 1442.0	22 ft at elev. 1442.0	8 ft at elev. 1441.0
(5) Side slopes	7, 3 & 2:1 U/S 2.5 w/10 ft berm D/S	2:1	2:1
(6) Zoning	Impervious core w/semi-imper- vious and per- vious D/S zones	-----Impervious core----- w/pervious D/S zone	

- (7) Impervious Core-----central core of "select impervious material"-----

a. Drainage Area - The drainage area consists of 1.5 square miles of heavily forested and predominantly mountainous terrain. About 6 percent of the drainage area is flat upland marsh and 16 percent of the drainage area is Cleveland Brook Reservoir itself.

b. Discharge at Dam Site - There are no records of discharges at the dam site.

- (1) Outlet works size.....30-inch diameter at invert elevation 1372.
- (2) Maximum known flood at damsite.....Unknown
- (3) Ungated spillway capacity at top of dam (no flashboards)
4,850 cfs @ 1442 elev.
- (4) Ungated spillway capacity at test flood elev. (with 2 ft. flashboards)
1,630 cfs @ 1440.35 elev.
- (5) Overflow spillway capacity at top of dam
1910 cfs @ 1442 elev.
- (6) Overflow spillway capacity at test flood elevation
570 cfs @ 1440.35 elev.
- (7) Combined spillway capacity at test flood elev. (with 2 ft. flashboards)
2,200 cfs @ 1440.35 elev.
- (8) Total project discharge at test flood elevation (with 2 ft. flashboards) 2,200 cfs @ 1440.35 elev.

c. Elevation (NGVD)

- (1) Streambed at centerline of dam-----1371
- (2) Test flood tailwater----- below elev. 1435
- (3) Upstream portal invert diversion tunnel-----N/A
- (4) Normal pool-----1435
- (5) Full flood control pool----- N/A
- (6) Spillway crest-----without flashboards---1435
with flashboards---1437
- (7) Design surcharge (Original Design)-----1438.7
(assume center 30-ft of flashboards collapsed (el. 1435), and remaining 50 ft. at el. 1437)
- (8) Top of dam-----1442
- (9) Test flood design surcharge-----1440.35

- h. Design and Construction History - The present Cleveland Brook Reservoir Dam was designed in 1948 by Metcalf & Eddy Engineers, Boston, Massachusetts and constructed by Tuller Construction Co. in 1949. A note on the record drawing titled Main Dam - West Section Plan states the following: "Sheeted cut-off trench back-filled with selected impervious material. Trench abandoned between Sta. 10+46 and Sta. 11+76 because of flowing sand. Effective cut-off made at 160 ft (-) upstream from centerline of dam". In a letter dated February 10, 1949 from the design engineer to the Berkshire County Engineer, a copy of which is included in Appendix B, the following statement is made: "A previous formation of sand and gravel encountered under the upstream cutoff west of the brook has made it seem advisable to deepen the cutoff excavation to a depth of some 20 ft. below the brook level for a short distance west of the brook. It is expected that the work on this cutoff will proceed as soon as weather is favorable. In the west abutment, the Contractor has elected to use open cut excavation in lieu of the sheeted trench contemplated by the Contract drawings, and this will be carried somewhat deeper than originally planned to reach satisfactory impervious material."

In 1963, the firm of Metcalf & Eddy designed a modification to the facilities to increase the reservoir height 5 feet. Shortly thereafter, the dam, dikes and spillway were raised accordingly. Due to observed seepage near the right abutment in the Winter of 1975, the same firm investigated the condition and prepared a report for the City of Pittsfield in 1977.

- i. Normal Operational Procedures - There are no formal operational procedures currently in effect for this facility. The dam is operated as a water supply dam according to the need for water in the City of Pittsfield. It appears to be well maintained and there appears to be dialogue about the dam between the City and design engineers on an as need basis.

- 1.3 Pertinent Data - The elevation for the reservoir shown on USGS Quadrangle Peru, Mass., 1973 is elevation 1429. The spillway crest elevation prior to raising the dam was elevation 1430. It is not known whether the USGS Quadrangle shows the reservoir outline for the spillway crest prior to 1966 in which case there is a 1 foot differential or the reservoir outline after 1966 in which case the differential between the contract plans and the Quadrangle Sheet would be 6 feet. All elevations shown in this report, therefore, are based on the elevations shown on the record plans for the dam, dikes and spillway which are assumed to be on NGVD (National Geodetic Vertical Datum).

feet below normal dike crest. The crest width in the overflow section is 16 feet and protected by riprap placed on bank run gravel. The upstream and downstream slopes are also protected by riprap placed on washed stone and bank run gravel. The approach and discharge slope to the overflow section is 2 horizontal to 1 vertical, and is in the same plane as the non-overflow portions of the dike.

The two dikes, Dike B and C, are separated by a reinforced concrete spillway. The spillway has a weir length of 80 feet and a crest elevation of 1435.0. There are provisions for placing stoplogs to elevation 1437. The concrete weir and sidewalls of the spillway are gravity sections. The approach channel has an impervious soil blanket invert protected by 6 inches of bank run gravel. Immediately in front of the weir, rock ballast has been placed on approximately a 1 to 1 slope. Immediately downstream of the weir, the invert of the channel is a reinforced concrete slab abutting up against the former spillway weir for the reservoir. The former weir has a crest elevation of 1430 and serves somewhat as an energy dissipator. The concrete apron of the former weir extends down the channel another 12 feet from the old weir.

- c. Size Classification - The hydraulic height of the dam is approximately 70 feet and the estimated total storage capacity at the top of the dam is 6,022 acre-feet. According to guidelines established by the Corps of Engineers, the dam is classified in the intermediate category based on both the storage capacity and the height of dam.
- d. Hazard Classification - The results of the dam failure analysis indicates a high potential for loss of life and property. The flood wave would pass through moderate to high density development areas in the Town of Dalton and the City of Pittsfield. Scores of residential homes, industrial and commercial buildings, and at least one high school would be affected. Over ten roadway bridges and about 7 mill dams would be overtopped. Consequently, the dam is in the "high" hazard classification.
- e. Ownership - The dam is owned by the City of Pittsfield, Massachusetts. The Owner is represented by Mr. Gerald Doyle, Commissioner of Public Works, 70 Alden Street, City Hall, Pittsfield, MA 01201 (Phone: 413/499-1100).
- f. Operator - Mr. Alfonso Yovis, Superintendent of Water Department is assigned responsibility for operation of the dam. His address is Water Department, City of Pittsfield, 235 Tyler Street, Pittsfield, MA 01201 (Phone: 413/443-6112).
- g. Purpose of the Dam - Cleveland Brook Reservoir is part of the water supply system for the City of Pittsfield, Massachusetts.

formed by a piece of 24-inch cast iron pipe through the control tower walls. Reinforced concrete structures with 2-inch cast iron pipe screens in front form the inlets to the 30-inch pipe intakes. The 24-inch cast iron pipe intake is protected with a piece of cast iron grating. The intake invert elevations are 1385, 1400 and 1415. The gate structure or control tower is divided into 2 chambers by a reinforced concrete wall. Three openings protected by screens, each 5 feet 4 inches high and 3 feet 6 inches wide penetrate the concrete dividing wall. The invert elevation for the openings is elevation 1385. The 30-inch water transmission main leading from the downstream chamber is gated within the control tower. The floor stands for the gate valves are manually operated and located on the operating floor within the control tower at elevation 1438. A bridge from the crest of the dam provides access to the control tower. The 30-inch water supply transmission main has a blowoff approximately 450 feet from the downstream toe of the dam. The 30-inch transmission main is also valved just downstream of the blowoff pipe.

Dike A has a maximum height of approximately 17 feet and a crest width of 22 feet. A paved roadway goes over the crest of the dike. The upstream and downstream slopes are 1 vertical to 2 horizontal. The upstream face of the dike is protected by riprap placed on washed stone. The downstream face of the dike is loamed and seeded. The core of the dike is constructed of impervious material with pervious material at the downstream toe. A cutoff trench filled with impervious material to a point 6 feet below the normal foundation of the dam is present at or near the center of the dike.

A 78-inch RCP diversion conduit, which may provide additional flow into the reservoir from Cady Brook and the East Branch of the Housatonic River, passes under Dike A and outlets into Cleveland Brook Reservoir. A reinforced concrete energy dissipator structure, having an invert elevation of 1408.0, forms the transition between conduit and reservoir. The structure is located approximately 70 feet into the reservoir from the toe of Dike A. Flow regulation is accomplished at the diversion structures located on Cady Brook (inv. elev. 1471.0) and at the East Branch of the Housatonic River (inv. elev. 1471.5). No means of flow regulation is present at Cleveland Brook Reservoir.

Dikes B and C at the spillway structure have a maximum height of approximately 11 feet. Dike C and the non-overflow portions of Dike B have a crest width of 8 feet and side slopes of 1 vertical to 2 horizontal. The upstream portion of these dikes are protected by riprap placed on washed stone and bank run gravel. The crest and downstream faces of the dikes are loamed and seeded. The core of the dikes are constructed of impervious material with a small area of pervious material at the downstream toe. A cutoff of select impervious material extending approximately 3 feet below the normal foundation of the dike is present at the centerline. Dike B, the most northerly of the two dikes, has a 135 foot long overflow section. The crest elevation of the overflow section is elevation 1439, which is 2

- b. Description of Dam and Appurtenances - The impoundment structures at Cleveland Brook Reservoir include a 1,650 foot long earth dam, an adjacent 690 foot long earth dike (Dike A) and a 415 foot long earth dike and spillway complex. The water supply intakes, the water supply gate structure and the reservoir drain are located at the main dam. A diversion conduit passes under Dike A and discharges into Cleveland Brook Reservoir near the dike's upstream face. The earth embankments on each side of the 80 foot long concrete spillway are known as Dike B and Dike C. A portion of Dike B is depressed for 135 feet in length to form an overflow spillway.

The main dam is a zoned earth embankment with a maximum height of 71 feet and a crest width of 17-1/2 feet. The upstream slope varies with a 1 vertical to 7 horizontal slope below elevation 1390, 1 vertical to 3 horizontal below elevation 1420 and 1 vertical to 2 horizontal below the crest of the dam at elevation 1442. The slope of the downstream face of the dam is 1 vertical to 2-1/2 horizontal with a 10-foot berm approximately at mid-height of the dam. The upstream face of the dam is protected with rip-rap bedded on washed stone in the upper regions and bank run gravel in the lower regions, all founded on a selected impervious blanket. The crest of the dam and the downstream face of the dam is loamed and seeded. The main core of the dam is of impervious material with a semi-impervious material and impervious material towards the downstream base. Selected pervious material is utilized as a toe drain for the dam. A cutoff trench of selected impervious material was placed along the upstream toe of the dam and at the higher portions of the dam an additional cutoff trench of selected impervious material was placed near the center of the dam.

A reservoir drain passes under the dam at approximately the center of the dam. The drain is a 30-inch pipe with concrete seep collars. A reinforced concrete structure is located at the inlet end of the drain. The structure contains an inlet formed of concrete, a sluiceway at the upstream end of the pipe and a manual gate operator. The operating level for the valve is at elevation 1390 which is below the reservoir water level at the normal pond elevation. The inlet invert elevation is 1372. The reservoir drain discharges at the downstream toe of the dam through a flap valve into a reinforced concrete structure with concrete energy dissipators.

A 30-inch water supply transmission main passes under the dam at approximately 1/3 of the distance in from the right abutment to a 15-foot internal diameter gate structure or control tower. There are three intakes to the structure. The two lower intakes are 30 inch diameter cast iron pipes while the upper intake is

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

CLEVELAND BROOK RESERVOIR DAM
MA 00225

SECTION 1: PROJECT INFORMATION

1.1 General

- a. Authority - Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Camp Dresser & McKee Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Camp Dresser & McKee Inc. under a letter of 27 March 1979, from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-79-C-0053 has been assigned by the Corps of Engineers for this work. Haley and Aldrich, Inc. has been retained by Camp Dresser & McKee Inc. for the soils and geological portions of the work.

- b. Purpose - The primary purpose of the investigation is to:
- (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 - (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
 - (3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location - Cleveland Brook Reservoir Dam is located on the south side of Frank Schnopps Road between Old Winsor Road and Stone House Road in the Town of Hinsdale, Massachusetts, as shown on the report's Location Map. The dam is at the headwaters of Cleveland Brook approximately 2 miles upstream of its confluence with the East Branch of the Housatonic River in Dalton, Massachusetts. The coordinates for the dam are 73 degrees-06.9 minutes longitude and 42 degrees-28.2 minutes latitude.

SECTION 4: OPERATIONAL PROCEDURES

- 4.1 Procedures - Although there is an informal routine for the operation of the dam, there is no written procedure.
- 4.2 Maintenance of Dam - It appears that there has been systematic maintenance of the dam and dike embankments.
- 4.3 Maintenance of Operating Facilities - The maintenance of the operating facilities is performed primarily on a demand basis. There is no written formal procedure established for the maintenance of the operating facilities. The operating facilities are primarily for the transmission of water to the City of Pittsfield and are operated as a part of performing this task. It was reported that the reservoir drain is not used on a regular basis and it is not maintained in operating condition. The center 30-ft. of the 80-ft. long by 2-ft high flashboards were designed to fail under an 0.5-ft. head.
- 4.4 Description of Any Warning System in Effect - There is no formal established warning system or emergency preparedness plan in effect for this structure.
- 4.5 Evaluation - Maintenance of the facility is being performed on an informal basis. The dam, dikes and spillway appear to have had systematic maintenance. It is recommended that a written maintenance procedure be compiled based on the maintenance work currently being performed in an informal manner. The maintenance procedure should include the maintenance of the reservoir drain. Formal operational procedures and warning systems and emergency preparedness plans should be established for the dam.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. General - The impoundment structures at Cleveland Brook Reservoir include a 1,650 foot long earth dam, a 690 foot long earth dike and a 415 foot long earth dike including an 80 foot long concrete spillway. The earth embankments on each side of the concrete spillway are known as Dike B and Dike C. The crest of Dike B is depressed (El. 1439) for 135 feet in length to form an overflow spillway. Crest elevation of Dike B and C is 1441 while the crest of Dike A and the main dam is at elevation 1442. The spillway crest is at elevation 1435 with no flashboards. Up to 2 feet of flashboards may be placed at the spillway.

Cleveland Brook Reservoir is located about at the headwaters of Cleveland Brook, approximately 2 miles upstream of its confluence with the East Branch of the Housatonic River. The reservoir serves as a water supply to the City of Pittsfield located about 7 miles downstream. Basically, the reservoir is a high-surge-low spillage project.

- b. Design Data - Metcalf & Eddy Inc., 50 Stanford Street, Boston, Massachusetts designed Cleveland Brook Reservoir in 1948, as well as the subsequent modifications in 1963. Hydraulic and hydrologic design data for the reservoir is in storage and not readily available. Some hydraulic/hydrologic information was retrieved and is presented in Section 1.3 and in Appendix B. In addition, a complete set of plans for the project was obtained from the City of Pittsfield and selected drawings are included in Appendix B. According to the design data included in Appendix B-19 and B-20, the design flood peak inflow was 2,000 cfs.
- c. Experience Data - No records of past floods are available for the dam site. Frank Schnopps Road, located about 90 feet downstream of the spillway, is normally flooded during the spring runoff.
- d. Visual Observation - At the time of the inspection in 1 May 1979, there was 2 feet of flashboards in place at the spillway. Both the main spillway and the overflow spillway appeared in good hydraulic condition. It was noted that the twin 18-inch culverts under Frank Schnopps Road provide limited hydraulic capacity and major discharges would flow over the roadway.

- e. Test Flood Analysis - Based upon the Corps of Engineers Guidelines, the recommended test flood for the size (intermediate) and hazard potential (high) is the the PMF (Probable Maximum Flood). The PMF was determined using the Corps of Engineers Guidelines for "Estimating Maximum Probable Discharges" in Phase I Dam Safety Investigations. The watershed terrain is generally "rolling" with a small marshy area in the southwest corner. The peak inflow rate for the 1.5 square mile watershed was determined to be 2,200 cfs/sq. mi. which yields a PMF inflow of about 3,350 cfs.

The evaluation of the effects of the test flood inflow is based on a spillway crest elevation of 1437. This assumes 2 feet of flashboards in place and corresponds to field conditions at the time of the inspection. Given this assumption, and the storage and spillway characteristics of the reservoir, the routed test flood outflow is about 2,200 cfs at a stage of 1440.35. The test flood overtops the overflow spillway by 1.35 feet with 1.65 feet of freeboard remaining with respect to the main dam and Dike A, and 0.65 feet of freeboard with respect to Dikes B and C. The depth of water above the flashboards is about 3.35 feet.

The immediate downstream channel has adequate capacity to carry the test flood without creating tailwater effects at the main and overflow spillways. Some flooding will occur at Frank Schnopps Road and at areas further downstream.

- f. Dam Failure Analysis - Based on Corps of Engineers Guidelines for estimating Dam Failure Hydrographs, and assuming a failure would occur along 40 percent of the mid-height length of the dam structure (434 feet), the peak failure outflow is estimated to be about 427,000 cfs. As a result of a dam failure, Old Windsor Road would be over-topped by about 25 feet in the flatter reaches and about 20 feet in the steeper reaches. About twelve (12) dwellings would be affected along the reach where Cleveland Brook winds around Old Windsor Road to the Wahconah Country Club. Cleveland Brook joins the East Branch of the Housatonic River at the Wahconah Country Club. The depth of flow through the country club would be about 25 feet at the center-line of the channel. The Wahconah Regional High School and several dwellings on the left bank plus over forty (40) dwellings on the right bank would be affected. The water depth over the bridge on the road connecting Routes 8 and 9 just downstream of the country club would be in excess of 10 ft. The dam failure outflow would then flow through Center Pond affecting scores of dwellings on both sides of the channel the Town of Dalton affecting scores of dwellings on both sides of the channel banks. The dam at Center Pond, as well as the six (6) mill dams downstream, would be overtopped. Five mills, together with many homes and a sewage disposal area would be affected between Center Pond and Hubbard Avenue. In the reach between Hubbard Avenue and East Street, several industrial buildings and a few dwellings would be affected. The estimated water surface elevation at the Penn Central Railroad bridge, which is just upstream of East Street, would be about 994 feet but the bridge would not be overtopped.

Downstream of East Street the dam failure outflow would wind through the City of Pittsfield overtopping several bridges and affecting development on both banks of river before reaching a point beyond Holmes Road where no further hazard would be expected.

It is clear that the dam failure outflow resulting from the failure of the Cleveland Brook Reservoir Dam would create a high potential for loss of life and property. Accordingly, the dam is classified in the high hazard category.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations - There was no visible evidence of dam, dike or spillway instability during the site examination on 1 May, 1979. Seepage was observed at the downstream toe of the right abutment of the main dam and at dikes B and C. The condition at the first main dam was first reported late in 1975 and observed during the site examination. Based on the report on the seepage and observations made during the visual examination, it is not considered to pose an immediate hazard to the stability of the downstream slope.
- b. Design and Construction Data - The design drawings for the construction and later modification of Cleveland Brook Reservoir Dam, copies of which are included in Appendix B, show cross-sections for the dam and dikes that incorporate the various usual features of dam design. While construction data for this project has not been reviewed, the design configuration appears reasonable. Assuming that the dam was constructed in accordance with the drawings, using materials with satisfactory permeability and filter characteristics, it would be expected to be adequately stable under static loading conditions.
- c. Operating Records - No records of embankment performance under prior maximum loading conditions are available. No instrumentation observations are available except for piezometer data obtained by Metcalf & Eddy in connection with their investigations of seepage at the right abutment of the Main Dam. These piezometer data, as reported by Metcalf & Eddy, do not indicate the need for urgent remedial measures with regard to stability of the Main Dam embankment.
- d. Post-Construction Changes - The height of the dam, dikes B and C and the spillway were raised 5 feet in 1966. Dike A was raised 6 feet during the same modification. No other post-construction changes are known.
- e. Seismic Stability - Cleveland Brook Reservoir Dam is located near the boundary between Seismic Zones 1 and 2 and in accordance with Recommended Phase I Guidelines does not warrant seismic analysis.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition - The visual examination of the Cleveland Brook Reservoir Dam and dike embankments revealed no conditions which warrant urgent remedial action. However, because of seepage conditions observed at Main Dam and at Dikes B and C, the overall condition of the project can be considered only fair.
- b. Adequacy of Information - The evaluation of the dam and dike embankments has been based primarily on the visual examination, consideration of available documents and past performance and application of engineering judgement. Generally, the information available or obtained was adequate for the purposes of the Phase I assessment. However, it is recommended that additional information relative to embankment seepage be obtained as outlined in Section 7.2.
- c. Urgency - The recommendations for additional investigations and remedial measures, outlined in Sections 7.2 and 7.3, respectively, should be undertaken by the Owner within one year after receipt of this report.
- d. Need for Additional Investigations - Additional investigations should be performed as outlined in Section 7.2.

7.2 Recommendations

It is recommended that the Owner arrange for the following investigations to be performed by a qualified registered professional engineer.

1. Evaluate the significance of the seepage conditions observed along the toe of the Main Dam and downstream from Dikes B and C. Consideration should be given to the effects of seepage conditions relative to long term embankment stability and an assessment of the need for remedial measures should be made.
2. Continue monitoring of piezometers installed near the right abutment of the Main Dam and implement remedial measures to control the seepage condition at that location.

The Owner should implement corrective measures as required, based on the results of the above engineering evaluations.

7.3 Remedial Measures

- a. Operation and Maintenance Procedures - It is recommended that the following remedial work be undertaken by the owner to correct deficiencies noted during the visual examination.
1. Continue to mow slopes at least once a year to permit visual inspection.
 2. Animal burrows in the embankments should be filled. An annual inspection should be made to check for burrowing activity and corrective action should be taken as required.
 3. Seepage conditions should be visually monitored on a regular basis at least until an assessment of the need for remedial measures is completed.
 4. Repair protective casing at piezometer B-4.
 5. Remove weed growth from concrete joints at the main spillway and remove debris from spillway apron.
 6. Repair deteriorated concrete, clean debris from the base slab and clean and paint the flap valve at the reservoir drain outlet structure. Check the outlet valve to ensure it is operational.
 7. Place stone at the dam end of the access bridge to the gate-house to bring approach to walkway grade.
 8. Remove soil and vegetation from the top of the blowoff structure and clean the outlet channel.
 9. Develop a formal maintenance program, operational procedure, emergency preparedness plan and warning system in cooperation with downstream communities.
 10. Institute a program of annual technical inspections.

7.4 Alternatives

There are no practical alternatives recommended.

APPENDIX A

INSPECTION TEAM ORGANIZATION AND CHECK LIST

Page No.

VISUAL INSPECTION PARTY ORGANIZATION

A-1

VISUAL INSPECTION CHECK LIST

Embankment: Dam	A-2, A-3
Embankment: Dike A	A-4
Embankment: Dike at Spillway (Dikes B & C)	A-5
Main Spillway	A-6
Outlet Works (Blow Off)	A-7
Control Tower & Service Bridge	A-8
Special Structure (Drainage Outlet Structure)	A-9

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

DAM: CLEVELAND BROOK RESERVOIR DAM

DATE: 1 MAY 1979

TIME: 1345

WEATHER: Broken Clouds - 65° F 10 to 15 mph wind

WATER SURFACE ELEVATION UPSTREAM: 2' of flashboards in place - water
is one inch below top of flashboards

STREAM FLOW: No Flow

INSPECTION PARTY:

1. Roger H. Wood, CDM
2. Joseph E. Downing, CDM
3. John Critchfield, H&A
4. Douglas G. Gifford, H&A
5.

PROJECT FEATURE	INSPECTED BY	REMARKS
1. <u>Spillway and Gatehouse</u>	<u>Roger H. Wood</u>	
2. <u>Embankments</u>	<u>Douglas G. Gifford</u>	
3. <u></u>		
4. <u></u>		

PRESENT DURING INSPECTION:

1. John Razzano - Pittsfield Water Dept.
2.
3.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: CLEVELAND BROOK RESERVOIR DAM

DATE: 1 MAY 1979

EMBANKMENT: DAM

BY: DGG & JWC

CHECK LIST	CONDITION
<p>1. Upstream Slope</p> <ul style="list-style-type: none"> a. Vegetation b. Sloughing or Erosion c. Rock Slope Protection - Riprap Failures d. Animal Burrows <p>2. Crest</p> <ul style="list-style-type: none"> a. Vegetation b. Sloughing or Erosion c. Surface Cracks d. Movement or Settlement <p>3. Downstream Slope</p> <ul style="list-style-type: none"> a. Vegetation b. Sloughing or Erosion c. Surface Cracks d. Animal Burrows e. Movement or Cracking near toe f. Unusual Embankment or Downstream Seepage g. Piping or Boils h. Foundation Drainage Features i. Toe Drains <p>4. General</p> <ul style="list-style-type: none"> a. Lateral Movement b. Vertical Alignment c. Horizontal Alignment d. Condition at Abutments and at Structures e. Indications of Movement of Structural Items f. Trespassing g. Instrumentation Systems 	<p>1.</p> <ul style="list-style-type: none"> a. Few weeds growing in riprap. b. None observed. c. Riprap (cobbles to 5 ft. pieces) to crest. Generally good condition, a few stones locally dislodged. d. None. <p>2.</p> <ul style="list-style-type: none"> a. Grass, mowed. b. Slightly rutted. c. None observed. d. Crest elevation varies up to ± 0.5 ft. (est.). <p>3.</p> <ul style="list-style-type: none"> a. Grass, mowed on upper portion. Lower portion has grass, weeds (cut) with occasional stump cut flush, up to 8 in. dia. Some brush on rock toe near right end. Paved gutters overgrown. b. Slope surface is irregular (est. 0.5 to 1.0 ft. variation from plane), esp. lower portion. No apparent sloughing. c. None observed. d. Two abandoned burrows noted. One just below berm, below gatehouse, one about 300 ft. left of gatehouse and about 15 ft. below crest. The later hole about 7 ft. into slope. e. None observed. f. Seepage from toe drain exits in area of drain outlet structure and in low area below gatehouse. Both areas wet and marshy, within 50 to 100 ft. of toe. Flow evident but no apparent soil movement. Seepage also emerging at embankment contact with right abutment, at level of berm. Seepage flowing along contact at toe at 1-2 gpm. No apparent soil movement. g. None observed.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: CLEVELAND BROOK RESERVOIR DAM

DATE: 1 MAY 1979

EMBANKMENT: DIKE A

BY: DGG & JWC

CHECK LIST	CONDITION
<p>1. Upstream Slope</p> <ul style="list-style-type: none"> a. Vegetation b. Sloughing or Erosion c. Rock Slope Protection - Riprap Failures d. Animal Burrows <p>2. Crest</p> <ul style="list-style-type: none"> a. Vegetation b. Sloughing or Erosion c. Surface Cracks d. Movement or Settlement <p>3. Downstream Slope</p> <ul style="list-style-type: none"> a. Vegetation b. Sloughing or Erosion c. Surface Cracks d. Animal Burrows e. Movement or Cracking near toe f. Unusual Embankment or Downstream Seepage g. Piping or Boils h. Foundation Drainage Features i. Toe Drains <p>4. General</p> <ul style="list-style-type: none"> a. Lateral Movement b. Vertical Alignment c. Horizontal Alignment d. Condition at Abutments and at Structures e. Indications of Movement of Structural Items f. Trespassing g. Instrumentation Systems 	<p>1.</p> <ul style="list-style-type: none"> a. Weeds growing in riprap. b. None observed. c. Riprap to crest, cobbles to 5 ft. pieces, good condition. d. None observed. <p>2.</p> <ul style="list-style-type: none"> a. Paved road 22 ft. wide, grass and weeds along edges. b. None observed. c. Occasional cracks in asphalt pavement. d. None observed. <p>3.</p> <ul style="list-style-type: none"> a. Grass & weeds, mowed. b. None observed. c. None observed. d. None observed. e. None observed. f. Area extending D/S from right half of embankment is wet and soft. No evidence of flow or soil movement. Wet area extends about 200 ft. D/S to swampy area, where water is ponded. g. None observed. h., i. None known. <p>4.</p> <ul style="list-style-type: none"> a. None observed. b. Good. Crest approx. 5.0 ft. above water. c. Dike curved. Crest width approx. 25 ft. D/S slope approx. 2H to 1V. d. Good. e. None observed. f. Minor. g. None known.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: CLEVELAND BROOK RESERVOIR DAM

DATE: 1 MAY 1979

EMBANKMENT: DIKE AT SPILLWAY (DIKES B & C)

BY: DGG & JWC

CHECK LIST	CONDITION
1. Upstream Slope a. Vegetation b. Sloughing or Erosion c. Rock Slope Protection - Riprap Failures d. Animal Burrows	1. a. Grass mowed. b. None observed. c. Riprap from cobble size to 3 ft. extends to crest level. d. None observed.
2. Crest a. Vegetation b. Sloughing or Erosion c. Surface Cracks d. Movement or Settlement	2. a. Grass, mowed, central 3.0 ft. at dike B utilized as emergency spillway; riprap from cobble size to 3 ft. placed on spillway area. b., c., d. None observed.
3. Downstream Slope a. Vegetation b. Sloughing or Erosion c. Surface Cracks d. Animal Burrows e. Movement or Cracking near toe f. Unusual Embankment or Downstream Seepage g. Piping or Boils h. Foundation Drainage Features i. Toe Drains	3. a. Grass mowed. b., c., e., e. None observed. f. Subgrade of roadway below dike C saturated; source could be com- bination of seepage beneath dike C and runoff from marshy high ground beyond roadway. Some seep- age at downstream toe at left training wall at dike B; no soil particle movement observed. g. None observed. h., i. None known.
4. General a. Lateral Movement b. Vertical Alignment c. Horizontal Alignment d. Condition at Abutments and at Structures e. Indications of Movement of Structural Items f. Trespassing g. Instrumentation Systems	4. a. None observed. b. Dike B crest 3.2 ft. above water level; emergency spillway top of riprap 2.0 \pm ft. above water level; overtopping flow would begin 1.0 \pm ft. below top of riprap. c. Consistent with design; no dis- placement noted. d. Good. e. None observed. f. Minor; tire tracks in grassed area downstream of emergency spillway. g. None observed.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: CLEVELAND BROOK RESERVOIR DAM

DATE: 1 MAY 1979

SPILLWAY: MAIN

BY: R. WOOD

CHECK LIST	CONDITION
1. Approach Channel a. General Condition b. Obstructions c. Log Boom etc.	1. a. Excellent. b. None c. None
2. Weir a. Flashboards b. Weir Elev. Control (Gate) c. Vegetation d. Seepage or Efflorescence e. Rust or Stains f. Cracks g. Condition of Joints h. Spalls, Voids Or Erosion i. Visible Reinforcement j. General Struct. Condition	2. a. 2' of flashboards in place good condition. b. None except flashboards. c. Minor (grass in joints). d. Surface wet - none observed. e. Surface wet - none observed. f. Surface wet - none observed. g. Generally good see also c. h. Laitance flaking off several locations. i. None observed. j. Very good.
3. Discharge Channel a. Apron b. Stilling Basin c. Channel Floor d. Vegetation e. Seepage f. Obstructions g. General Struct. Condition	3. a. Concrete apron - much grass in joints, some rocks on apron. b. Concrete sill, few spalls left side - appears to be from vandals with rocks. c. Immediate channel well grassed to road. d. See c. e. Not observable. f. Channel downstream of road overgrown many young trees. g. Spillway itself and drop inlet in good condition.
4. Walls a. Wall Location _____ (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition	4. a. Side Walls (1) None observed. (2) Seepage at junction of new & old concrete (at face). Seepage from behind or just below D/S end of walls. (3) None observed. (4) Shrinkage cracks & surface crazing right wall. (5) Construction joints cracking. (6) None observed. (7) None observed. (8) Good.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

AM: CLEVELAND BROOK RESERVOIR DAM

DATE 1 MAY 1979

UTLET WORKS: BLOW OFF

BY: R. WOOD

CHECK LIST	CONDITION
<ul style="list-style-type: none"> . Inlet <ul style="list-style-type: none"> a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates . Control Facility <ul style="list-style-type: none"> a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks . Outlet <ul style="list-style-type: none"> a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks . Mechanical and Electrical <ul style="list-style-type: none"> a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection . Other 	<ul style="list-style-type: none"> 1. See control tower. 2. <ul style="list-style-type: none"> a. Valve vaults - concrete moss covered. b. N/A c. N/A d. Valves not operated recently. e. Buried, not observable. f. None observed. 3. <ul style="list-style-type: none"> a. Concrete in good condition moss covered. b. None observed. c. Invert silted, branches in outlet channel. d. None observed. 4. Gates manually operated. <ul style="list-style-type: none"> a. - f. Not applicable.

12. Remarks & Recommendations: [Fully Explain]

Mr. L. Newbill, J. Pierce, and A. Gerlach, from the Pittsfield Water Department were present at the inspection.

The dam appears to be in good condition. There is no settlement in the embankment or sloughing on the slopes. The top of the dam and the downstream slope are well mowed. There is a fairly heavy brush growth on the lower level near the toe, but is of minor concern.

The spillway is in good condition, at the present time there are 24" of flash boards in place. There is no evidence of cracks, spalling, or seepage.

The Pittsfield Water Department is doing a good job in checking and maintaining this dam.

13. Overall Condition:

1. Safe X
2. Minor repairs needed
3. Conditionally safe - major repairs needed
4. Unsafe
5. Reservoir impoundment no longer exists [explain]
Recommend removal from inspection list

APPENDIX B-10

L-162 A

- 2 -

DAM NO. 1-2-132-4

8. Downstream Face of Dam: Condition: 1. Good X 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

9. Emergency Spillway: Condition: 1. Good _____ 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

10. Water level at time of inspection: 8 ft. above _____ below x _____
top of dam _____
principal spillway x _____
other _____

11. Summary of Deficiencies Noted:

Growth [Weeds and Brush] on Embankment X _____
Animal Burrows and Washouts _____
Damage to slopes or top of dam _____
Cracked or Damaged Masonry _____
Evidence of Seepage _____
Evidence of Piping _____
Erosion _____
Leaks _____
Trash and/or debris impeding flow _____
Clogged or blocked spillway _____
Other _____

APPENDIX B-9

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/Town WINDDALE Dam No. 1-2-132-4.
 Name of Dam Cleveland Reservoir Inspected by: R D Jordan.
 Date of Inspection 9-18-72.

2. Owner/s: per: Assessors _____ Prev. Inspection X _____.
 Reg. of Deeds _____ Pers. Contact _____.

1. City of Pittsfield City Hall Pittsfield, MA 499-1100
 Name St. & No. City/Town State Tel. No.

2. _____
 Name St. & No. City/Town State Tel. No.

3. _____
 Name St. & No. City/Town State Tel. No.

3. Caretaker [if any] e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.
Louis Newbill City Hall Pittsfield, MA 499-1100
 Name St. & No. City/Town State Tel. No.

4. No. of Pictures taken 3.

5. Degree of Hazard: [if dam should fail completely]*

1. Minor _____ 2. Moderate _____
 3. Severe _____ 4. Disastrous X _____

*This rating may change as land use changes [future development]

6. Outlet Control: Automatic _____ Manual X _____
 Operative X yes: _____ no: _____

Comments: _____

7. Upstream Face of Dam: Condition:
 1. Good X 2. Minor Repairs _____
 3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

APPENDIX B-8

INSPECTION OF DAMS

City or Town of Hinsdale Date June 11, 1971
Name of Dam Cleveland Reservoir Inspector R. Northrup & P. Fezzie
Owner City of Pittsfield Address City Hall, Pittsfield, Mass.
Caretaker City of Pittsfield Address City Hall, Pittsfield, Mass.
Location South of Frank Schnopps Road.
Type of Dimensions Earth fill 1600' long, 71' high. Road over top.

Spillway, type and size Concrete 80' long, 5' freeboard.
Outlets, type and size 30" supply, 30" feed.
Flashboards, type and height 24" wood.
Date Built 1949 Condition Good
When last repaired 1963 By whose orders Owners
Nature of Repairs Level raised 5' adding 350 MG to capacity.

Purpose of Dam Water supply.
Approximate storage of water 1.575 billion gallons.
Approximate area of water shed Small diversion area has 11 square miles.
Possible damage due to failure of dam Disastrous.

Remarks Water 8" below top of flashboards. Growth on toe of embankment. Small amount of seepage at isolated spots on toe of embankment. Unable to ascertain whether seepage or surface runoff causes these isolated wet spots.

Recommendations Check toe of embankment periodically for signs of serious seepage. Growth at toe is not serious and helps to prevent erosion.

FILE

COUNTY OF BERKSHIRE, MASS.
INSPECTION OF DAMS

City or Town of Hinsdale Date 12, August 1966

Name of Dam Cleveland Inspector Louis J. Diamond

Owner City of Pittsfield Address 33 Pearl St. Tel. _____
John Daniels Comm. P.W.

Caretaker Albert Goerlach Address Hinsdale, Mass. Tel. _____

Location S.W. Cor. of Hinsdale

Type and Dimensions Earth fill-1600' lg. 71' high. (66)

Spillway, type and size Conc. 80' lg- 5' freeboard.

Outlets, type and size 30" supply-30" feed.

Fleshboards, type and height 24" wood.

Date Built 1948-49 Condition Good-Excellent.

When last repaired 1963 By whose orders Owners
Added 350,000,000 gals to capacity.

Nature of Repairs Raised level 5'

Purpose of Dam Water supply City of Pittsfield

Approximate storage of water 1,525,000,000 gals.

Approximate area of water shed Small Diversion area has 11 sq. mi.
Disastrous

Possible damage due to failure of dam _____

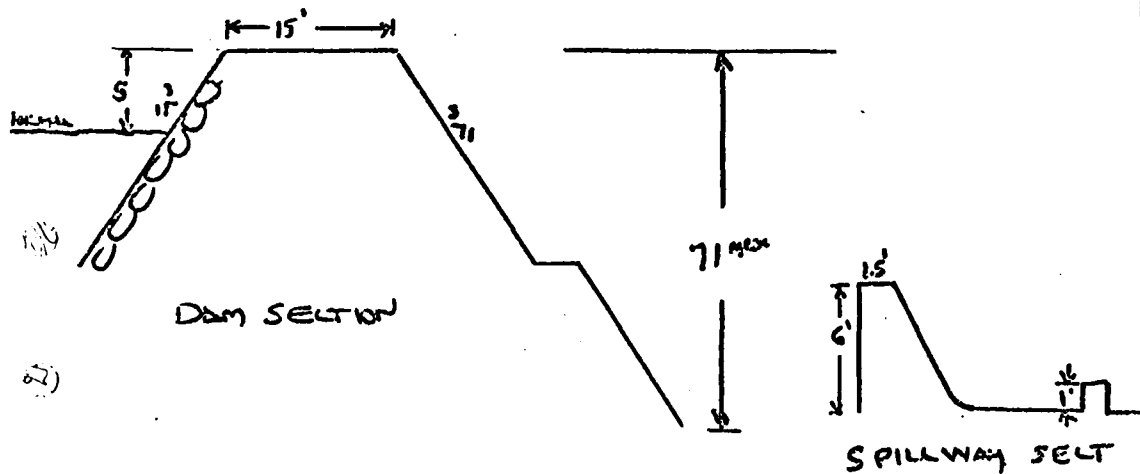
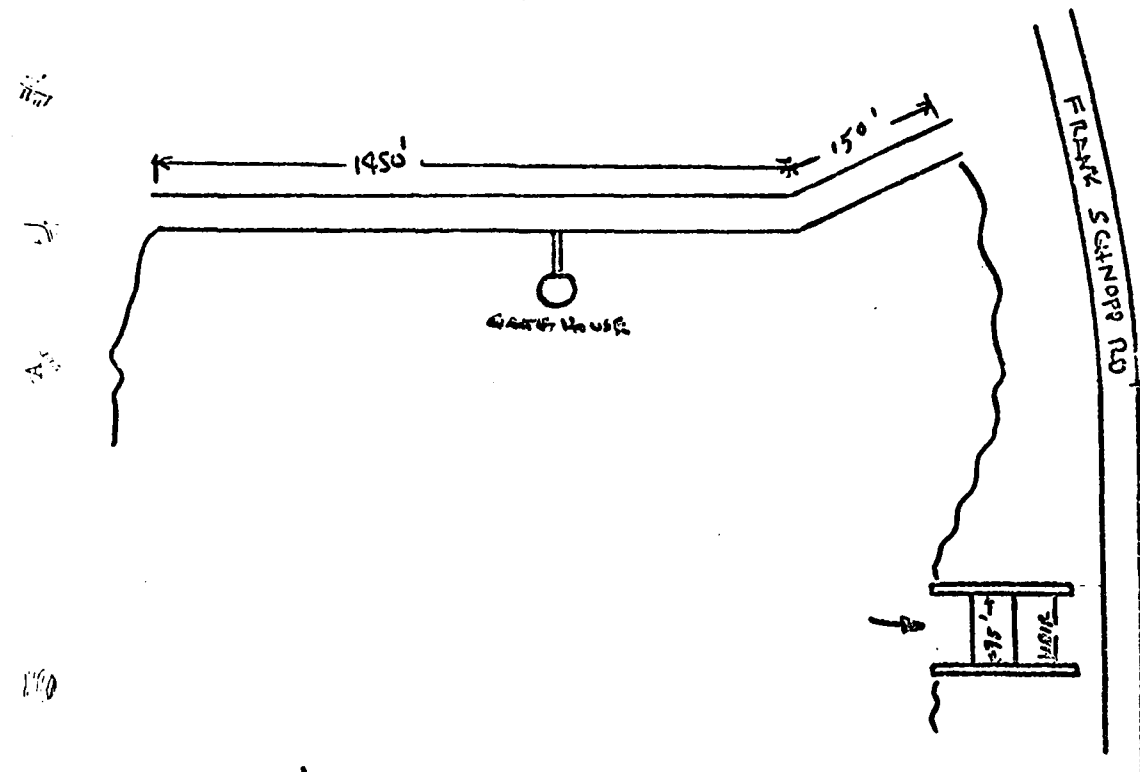
Remarks Water 12" below lip of conc. spillway.

Recommendations Growth on top and slopes should be removed.
move growth developing in rip-rap near gatehouse.



APPENDIX B-5

CLEVELAND RES. 1-2-132-4



L-169 A

DAM NO. 1-2-132-4.

10. Risk to life and property in event of complete failure.

No. of people 500+

No. of homes 100±

No. of Businesses 2

No. of Industries 1

Type Papermaking

No. of Utilities _____

Type _____

Railroads _____

Other dams Byron Weston

Other Regional High School

11. Attach Sketch of dam to this form showing section and plan on 8-1/2" x 11" sheet.

DESCRIPTION OF DAM

DISTRICT ONESubmitted by R D JordanDam No. 1-2-132-4Date 7-23-72City/Town HINSDALEName of Dam Cleveland Reservoir

1. Location: Topo Sheet No. 5-B

Provide 8-1/2" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year built: 1949 Year/s of subsequent repairs 1963

3. Purpose of Dam: Water Supply X Recreational _____
Irrigation _____ Other _____

4. Drainage Area: 11 sq. mi. _____ acres.

5. Normal Ponding Area: _____ Acres; Avg. Depth _____
Impoundment: 1.575 Bill. gals; _____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir - -
i.e. summer homes etc. _____

7. Dimensions of Dam: Length 1600' Max. Height 71'
Slopes: Upstream Face 3/1 earth, stone faced
Downstream Face 3/1 earth
Width across top 15'

8. Classification of Dam by Material:
Earth X Conc. Masonry _____ Stone Masonry _____
Timber _____ Rockfill _____ Other _____

9. A. Description of present land usage downstream of dam: _____
50 % rural; 50 % urban.
B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure
Yes _____ No X

APPENDIX B-2

LIST OF AVAILABLE DOCUMENTS
CLEVELAND BROOK RESERVOIR DAM

DOCUMENT

LOCATION

- | | |
|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Original Cleveland Brook Reservoir Dam Construction Drawings (38 sheets) and Specifications, May 1948. | Metcalf & Eddy Engineers
50 Staniford Street, Boston, MA 02114
And
City of Pittsfield, City Hall
70 Alden Street, Pittsfield, MA 01201 |
| 2. Drawings (5 sheets) for the Alterations to Cleveland Brook Reservoir Dam, January 1963 | Metcalf & Eddy Engineers
50 Staniford Street, Boston, MA 02114
And
City of Pittsfield, City Hall
70 Alden Street, Pittsfield, MA 01201 |
| 3. Report on Seepage at Cleveland Brook Reservoir Dam, December 1976 | Metcalf & Eddy Engineers
50 Staniford Street, Boston, MA 02114
And
City of Pittsfield, City Hall
70 Alden Street, Pittsfield, MA 01201 |

1973 REPORT ON SEEPAGE EXCERPTS

DESCRIPTION

Page No.

Reference letter dated July 28, 1976

B-34

Plan of Boring Logs

B-35

Results of Insitu Falling Head Permeability Tests

B-36

Piezometers - Location and Water Level Measurements

B-37

Boring Logs

B-38 to B-50

APPENDIX B

LIST OF AVAILABLE DOCUMENTS AND PRIOR INSPECTION REPORTS

DOCUMENTS

List of Available Documents
Description of Dam (by Mass. Div. of Waterways)

Page No.

B-1
B-2 to B-5

PRIOR INSPECTION REPORTS

DATE

BY

Page No.

August 12, 1966	County of Berkshire, Mass.	B-6
June 11, 1971	Mass. Div. of Waterways	B-7
September 28, 1972	Mass. Div. of Waterways	B-8 to B-10
January 29, 1974	Mass. Div. of Waterways	B-11 to B-13
November 5, 1975	Mass. Div. of Waterways (Supplementary Report to January 29, 1974)	B-14

DESIGN AND CONSTRUCTION DATA

DATE

BY

Page No.

June 9, 1948	Metcalf & Eddy, Engineers	B-15
February 10, 1949	Metcalf & Eddy, Engineers	B-16
January 7, 1963	Metcalf & Eddy, Engineers	B-17
January 14, 1963	Metcalf & Eddy, Engineers	B-19

DRAWINGS

No.

TITLE

Page No.

1	Main Dam-West Section Plan	B-21
2	Main Dam-East Section Plan	B-22
3	Dam and Dike, Typical Sections	B-23
4	30" Drain Profile & Intake Details	B-24
5	30" Supply Main Profile & Details	B-25
6	Gate Structure Mechanical Details	B-26
7	Boring Data	B-27
8	Boring Data	B-28
9	Boring Data	B-29
10	Boring Data	B-30
11	Dam-Plan & Sections, Dike A, B & C - Sections	B-31
12	Spillway - Plan & Sections	B-32
13	Diike A - Plan & Profile, Collapsible Flashboards Details & Sections	B-33

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: CLEVELAND BROOK RESERVOIR DAM

DATE: 1 MAY 1979

SPECIAL STRUCTURE: DRAINAGE OUTLET STRUCTURE

BY: R. WOOD

CHECK LIST	CONDITION
1. Outlet structure	<p>1.</p> <ul style="list-style-type: none"> a. Flap valve rusted and some debris present may prevent opening. b. Flow (slight) out of drain pipe in right wall. c. Flow along left toe of dam coming out from behind left wingwall. d. Flow coming out from behind right wing wall. e. Right wing wall has deteriorated top and exposed front face - much efflorescence. f. Moss at top of headwall. g. Left wall & energy dissipators in good condition (concrete). h. Alge growth in channel between walls. i. Channel D/S overgrown with marsh grass with some young trees. Branch debris present.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: CLEVELAND BROOK RESERVOIR DAM

DATE: 1 MAY 1979

CONTROL TOWER AND SERVICE BRIDGE:

BY: R. WOOD

CHECK LIST

CONDITION

1. Control Tower
 - a. Seepage or Efflorescence
 - b. Rust or Stains
 - c. Cracks
 - d. Condition of Joints
 - e. Spalls, Voids or Erosion
 - f. Visible Reinforcement
 - g. General Struct. Condition
2. Service Bridge Superstructure
 - a. Bearings and Anchor Bolts
 - b. Longitudinal Members
 - c. Transverse Members
 - d. Bracing
 - e. Underside of Deck
 - f. Deck
 - g. Expansion Joints
 - h. Drainage System
 - i. Railings
 - j. Paint
3. Service Bridge Abut. & Piers
 - a. Bridge Seat
 - b. Backwall
 - c. Abut. Alignment
 - d. Bridge Approach
 - e. General Struct. Condition
4. Equipment

1.
 - a. Slight on inside of brick.
 - b. None observed.
 - c. None observed.
 - d. None observed.
 - e. None observed.
 - f. None observed.
 - g. Roof excellent, walls & floor good
Water to bot of operational floor;
substructure not visible.
2.
 - a. Very good.
 - b. Very good.
 - c. Not observable.
 - d. Not observable.
 - e. Not observable.
 - f. Not observable.
 - g.
 - h. None
 - i. Good.
 - j. Good.
3.
 - a. Excellent.
 - b. Excellent.
 - c. Good.
 - d. Approach low.
 - e. Excellent.
4. Intake valve (3) are well main-
tained and operational. 1 outlet
valve maintained and operational
chain fall operational - Support
beam in excellent condition.
2 lifting U bolts in good condition.

L-108

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: ~~XXX~~/Town HINSDALE. Dam No. 1-2-132-4.
Name of Dam Cleveland Reservoir. Inspector by: RD Jordan-PF Fezzie.
Date of Inspection 1/29/74.

2. Owner/s: per: Assessors_____. Prev. Inspection X.
Reg. of Deeds_____. Pers. Contact_____.

1. City of Pittsfield City Hall Pittsfield 499-1100
Name St. & No. City/Town State Tel. No.
2. _____
Name St. & No. City/Town State Tel. No.
3. _____
Name St. & No. City/Town State Tel. No.

3. Caretaker [if any] e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.
Louis Newbill City Hall Pittsfield, MA 499-1100
Name St. & No. City/Town State Tel. No.

4. No. of Pictures taken 4.

5. Degree of Hazard: [if dam should fail completely]*
1. Minor_____. 2. Moderate_____.
3. Severe_____. 4. Disastrous X.

*This rating may change as land use changes [future development]

6. Outlet Control: Automatic_____. Manual X.
Operative X yes. _____ no.
Comments: _____

upstream face of Dam: Condition:
1. Good X. 2. Minor Repairs_____.
3. Major Repairs_____. 4. Urgent Repairs_____.
Comments: _____

APPENDIX B-11

8. Downstream Face of Dam: Condition: 1. Good X 2. Minor Repairs_____
3. Major Repairs____ 4. Urgent Repairs_____

Comments: _____

9. Emergency Spillway: Condition: 1. Good X 2. Minor Repairs_____
3. Major Repairs____ 4. Urgent Repairs_____

Comments: _____

10. Water level @ time of inspection: 7 ft. above____ below X____
top of dam_____
principal spillway X_____
other_____

11. Summary of Deficiencies Noted:

Growth [Trees and Brush] on Embankment X_____
Animal Burrows and Holes_____
Damage to slopes or top of dam_____
Cracked or Damaged Masonry_____
Evidence of Seepage_____
Evidence of Piping_____
Erosion_____
Leaks_____
Trash and/or debris impeding flow_____
Clogged or blocked spillway_____
Other_____

12. Remarks & Recommendations: [Fully Explain]

This dam is well maintained and in very good condition. The concrete spillway is in good shape; no cracks or spalling was noted. The flashboards are in place, and appear to be sound.

There is some widely scattered brush growing through the upstream rock slope. It would be a very minor task to remove this growth. A fairly heavy growth of brush covers the lower downstream slope and toe. The Pittsfield Water Department has informed me that this will be removed during the summer of 1974. The toe of the dam is dry and stable. No wet or spongy areas were found.

In my opinion the dam is safe.

The description of this structure was submitted in 1972. There are no changes to be noted.

For location see Topo Sheet 5-B.

13.

Overall Condition:

1. Safe ☒
 2. Minor repairs needed ☐
 3. Conditionally safe - major repairs needed ☐
 4. Unsafe ☐
 5. Reservoir impoundment no longer exists [explain] ☐
- Recommend removal from inspection list ☐

APPENDIX B-13

12. Remarks & Recommendations: (Fully Explain) Prev. Insp. date 1-29-74

SUPPLEMENTARY REPORT-CLEVELAND RESERVOIR DAM HINSDALE, MASS.

On Wednesday, November 5, 1975, I inspected the downstream slope of the dam to investigate reports of heavy seepage at the right abutment. Inspection of the abutment area verified the reports. Approximately five feet above the berm, an area of seepage exists that was observed in 1974. Free water (approx. 2 gpm) was flowing from the center of the spongy area. The flow was clear, no fines were being carried away, however, evidence of previous soil displacement was noted. Within a radius of three feet of the outfall the slope was very unstable. I could penetrate the slope 2' - 3' with a 1" sapling with very little effort.

Since the leak and seepage was not noted in the 1971, 72, and 74 Dept. inspection reports, I researched the County Engineer's records. No mention of this condition was contained in any report dating back to the construction of the dam.

The Pittsfield Water Dept. was notified and advised to take appropriate action. An engineering firm retained by the City, has been investigating the condition for several weeks.

Although the leak is probably nothing more than a spring originating at old ground adjacent to the abutment, the size and location of the structure warrant a full investigation.

I will forward to your office all future information I receive concerning this matter.

13. Overall Condition:

1. Safe_____.
2. Minor repairs needed_____.
3. Conditionally safe - major repairs needed_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list_____.

METCALF & EDDY
Engineers
Boston, Mass.

June 9, 1948
NC/d

Pittsfield, Mass.
Cleveland Brook Water Supply
Reservoir and Diversion Works
Design Data

Reservoir

Capacity	1500 million gallons
Surface Area	145 acres
Safe Yield	8 million gallons per day
Design Capacity of Supply Main from Reservoir	13.5 " " " "

Dam

Length	1600 feet
Maximum Height	66 "
" Width	530 "
Freeboard - Main Dam	7 "
Dike	6 "
Water Surface	El. 1430
30" Drain Outlet	El. 1371
30" Supply Main Outlet	El. 1385

Spillway

Crest Length	80 feet
" Elevation	1430
Normal water level overflow	1429
Freeboard	5 feet
Design Depth	2.5 "
Design Flood Peak (equivalent to 980 cfs./sq.mi. plus 450 cfs. from diversion conduit)	2000 cubic feet per second
Design Discharge Peak	900 cubic feet per second

Diversion Works

Conduit Capacity	430 cubic feet per second
Cady Brook Diversion	
Drainage Area	3.6 square miles
Overflow Spillway Length	60 feet
Capacity of Spillway	2100 cubic feet per second
	580 cfs./sq.mi.
East Branch Diversion	
Drainage Area	7.4 square miles
Overflow Spillway Length	70 feet
Capacity of Spillway	2800 cubic feet per second
	380 cfs./sq.mi.

FRANK A. HARBSTON
JOHN P. WENTWORTH
HARRISON P. EDDY, JR.
ARTHUR L. SHAW
E. SHERMAN CHASE
FRANK L. FLOOD
ALMON L. FALES
CONSULTANT

METCALF & EDDY ENGINEERS

STATLER BUILDING
BOSTON 16, MASS.

INVESTIGATIONS AND RESEARCH
PLANS AND SPECIFICATIONS
SUPERVISION OF CONSTRUCTION
SUPERVISION OF OPERATION
MANAGEMENT VALUATIONS
LABORATORY FOR CHEMICAL
AND BIOLOGICAL ANALYSES

CABLE ADDRESS — "METEOD" — BOSTON

FILE

J-Pittsfield
Cleveland

February 10, 1949

Mr. Harry W. Hoachy
County Engineer
Berkshire County Court House
Pittsfield, Massachusetts

Dear Mr. Hoachy:

In order to keep you posted on the progress of the construction of Cleveland Brook dam in Hinsdale, there are two contemplated changes from the Contract Drawings which we believe you will be interested to know about.

A pervious formation of sand and gravel encountered under the upstream cutoff west of the brook has made it seem advisable to deepen the cutoff excavation to a depth of some 20 ft. below the brook level for a short distance west of the brook. It is expected that the work on this cutoff will proceed as soon as weather is favorable. In the west abutment, the contractor has elected to use open cut excavation in lieu of the sheeted trench contemplated by the Contract drawings, and this will be carried somewhat deeper than originally planned to reach satisfactory impervious material.

It is anticipated that when weather conditions are favorable you will visit the job and our resident engineer will be glad to discuss all phases of the work with you.

Yours very truly,

METCALF & EDDY

By- *Arthur L. Shaw*
Arthur L. Shaw

NC/p

c/c to Mr. Whittier
Mr. Cannon

BOSTON • NEW YORK • PALM BEACH • PORT OF SPAIN

METCALF & EDDY

ENGINEERS

STATLER BUILDING
BOSTON 10 - MASSACHUSETTS
BOTH OFFICES OPEN

January 7, 1963

J - 5973

Mr. John Bradford
Chief Waterways Engineer
Division of Waterways
Mass. Dept. of Public Works
100 Nassau Street
Boston, Massachusetts

Dear Mr. Bradford:

We have been engaged by our client, the City of Pittsfield, Massachusetts, to prepare plans and specifications for raising the height of the City's Cleveland Brook water supply dam. The question is whether this project would require the approval of the Division of Waterways. We shall, of course, submit final plans and specifications to the Berkshire County Commissioners for approval.

The dam was constructed in 1949 on Cleveland Brook in the Town of Hinsdale about 2-1/2 miles north of Dalton. The dam consists of an earth embankment and one dike across Cleveland Brook. A low concrete spillway is located at a saddle in the easterly side of the reservoir basin about one-half mile southeasterly of the dam. The earth embankment has a maximum height of 66 ft. and a top width of 40 ft. The spillway is 1 ft. high and 80 ft. long with a depth of 5 ft. Stop logs 2 ft. high are on the crest of the spillway. The difference in elevation between the top of the dam and the crest of the spillway is 7 ft.

The dike has been designed as a fuse plug to permit overflow should water level in the reservoir approach within one foot of the top of the dam. The tributary drainage area of the dam is 1.5 square miles.

INVESTIGATIONS • REPORTS • DESIGNS • SUPERVISION OF CONSTRUCTION • SUPERVISION OF OPERATION
MANAGEMENT • VALUATIONS • LABORATORIES • RESEARCH

APPENDIX B-17

Mr. John Bradford

January 7, 1964

NETCALF & EDDY

2

ENGINEERS

We plan to raise the top of the dam. A new spillway crest will be constructed 5 ft. higher than the existing one. The new spillway section will be flanked by two earth dikes. One of these new dikes will be designed as an emergency overflow should the water in the reservoir approach within 2 ft. of the crest of the dam. The existing dike will be raised to the elevation of the new crest of the dam. The crest of the spillway will be provided with 2 ft. high flashboards. The center 30 ft. of these boards will be designed to collapse with water 0.5 ft. over the top of the boards.

Since we plan to advertise for bids in the very near future, it would be appreciated if the approval of the Division of Waterways of this project, if required, could be furnished us at the earliest possible date.

If you should require additional information, please contact us.

Very truly yours,

NETCALF & EDDY

283
GRT:m

Walter Perry
Project Engineer

INVESTIGATIONS • REPORTS • DESIGNS • SUPERVISION OF CONSTRUCTION • SUPERVISION OF OPERATION
MANAGEMENT • VALUATIONS • LABORATORIES • RESEARCH

METCALF & EDDY

ENGINEERS

STATLER BUILDING
POSTON 10 - MASSACHUSETTS
(AREA OFFICE - NEW YORK)

January 14, 1963

PRINCIPAL DESIGN DATA FOR ALTERATIONS TO CLEVELAND BROOK DAM

Reservoir

Drainage area, sq. mi.	1.5
Area of water surface (Top of existing flashboards	
El. 1432) acres	137
Area of water surface (Top of new flashboards	
El. 1437) acres	160
Capacity (Below top of existing flashboards)	
El. gals 1431	
Capacity (Below top of new flashboards) El. gals 1704	

Dam

El. top of dam (existing)	1437
El. top of dam (raised)	1442
Increased height of dam, ft.	1445
Top width of dam (existing), ft.	40
Top width of dam (raised), ft.	17.5
Max. height of dam (existing), ft.	66
Max. height of dam (raised), ft.	71
Existing freeboard above flashboards (El. 1432), ft.	5
New freeboard above flashboards (El. 1437), ft.	5

Spillway

Length of spillway, ft.	80
El. top spillway crest (existing)	1430
El. top spillway crest (new)	1435
El. top flashboards (existing)	1432
El. top flashboards (new)	1437
El. top existing abutments	1435
El. top raised abutments	1441
Freeboard at abutments above top of flashboards (existing), ft.	3
Freeboard at abutments above top of flashboards (new), ft.	4

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MANAGEMENT • VALUATIONS • LABORATORIES • RESEARCH

Spillway (Cont'd)

El. water surface at design flood (existing flashboards in place)	1438.3
El. water surface at design flood (new flashboards with center 30 ft. collapsed and remainder in place)	1438.7
Freeboard at design flood (existing flashboards in place), ft.	9.7
Freeboard at design flood (new flashboards with center 30 ft. collapsed and remainder in place) ft.	8.3
Design peak discharge at spillway, c.f.s.	900
Design flood peak inflow to reservoir, c.f.s.	2000

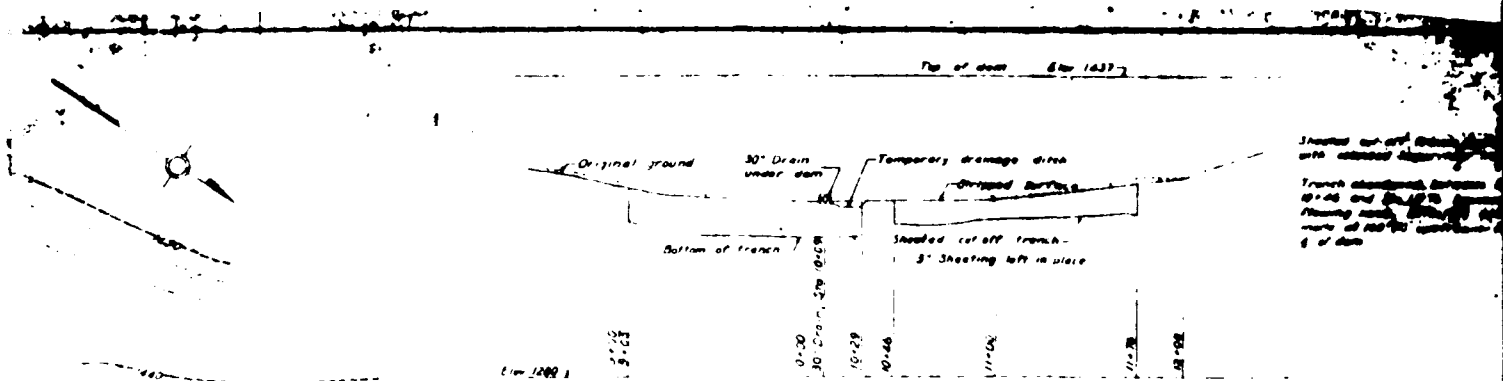
The design flood peak inflow to the reservoir is based on a run-off from the drainage area of 1000 c.f.s./sq. mi. or 1500 c.f.s. Added to this is the capacity of the diversion of approximately 900 c.f.s. from Gully and Window Brooks making a peak inflow to the reservoir of 2000 c.f.s.

The design peak discharge at the spillway of 900 c.f.s. is a result of the peak inflow to the reservoir being modified by the storage capacity of the reservoir above the top of the flashboards.

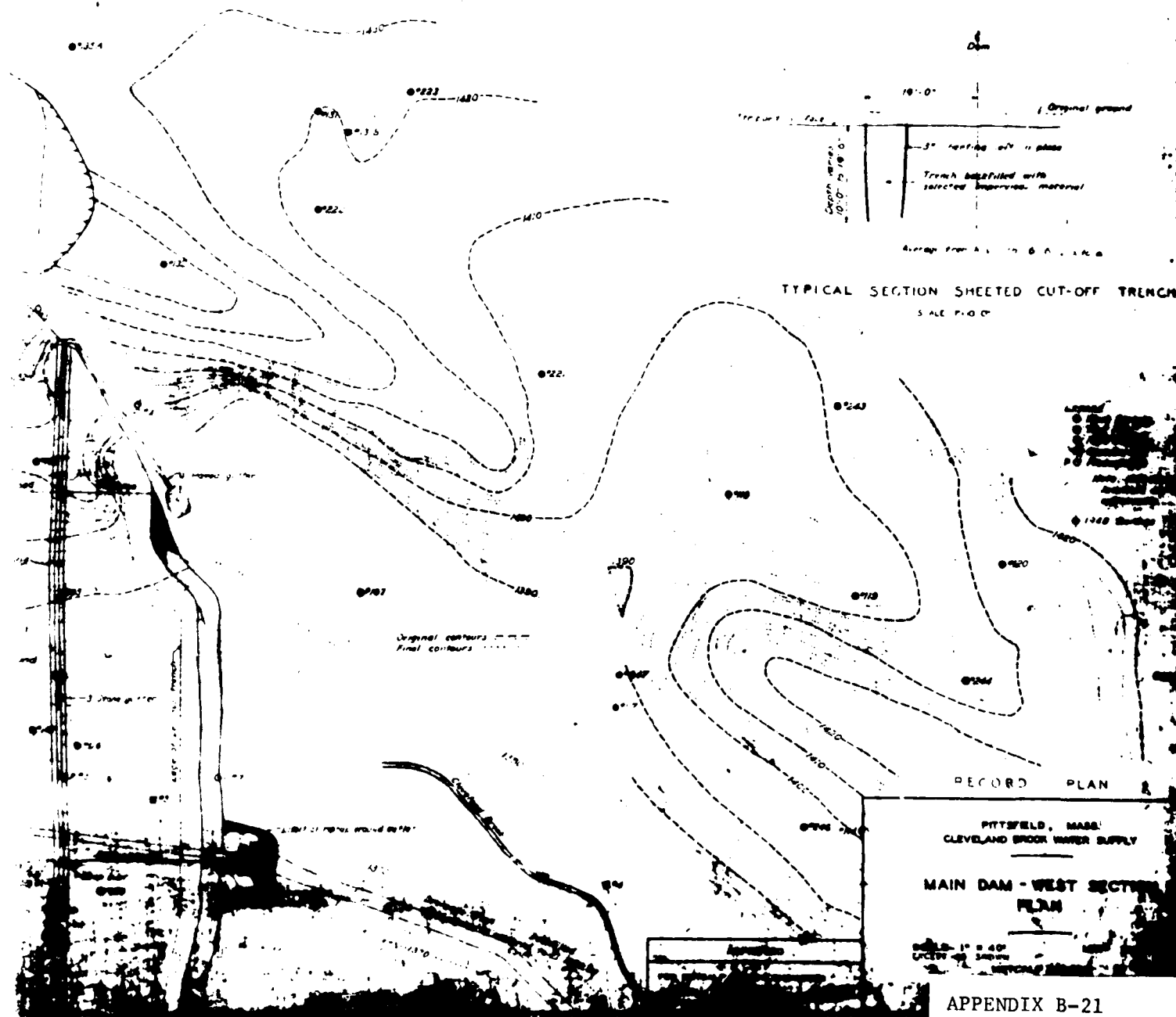
Discharge over the spillway was determined by the following formula:

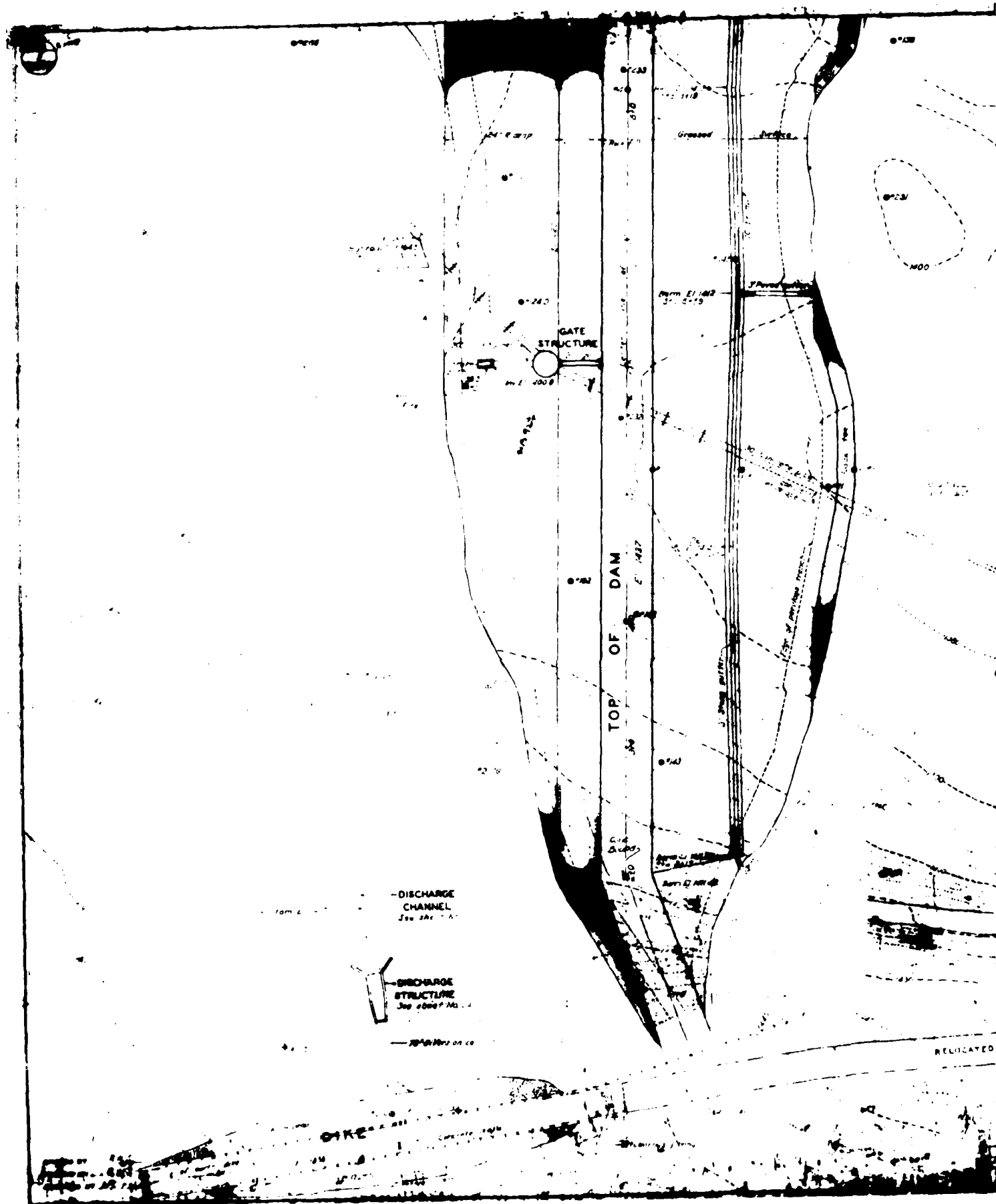
$$Q = CLH^{3/2}$$

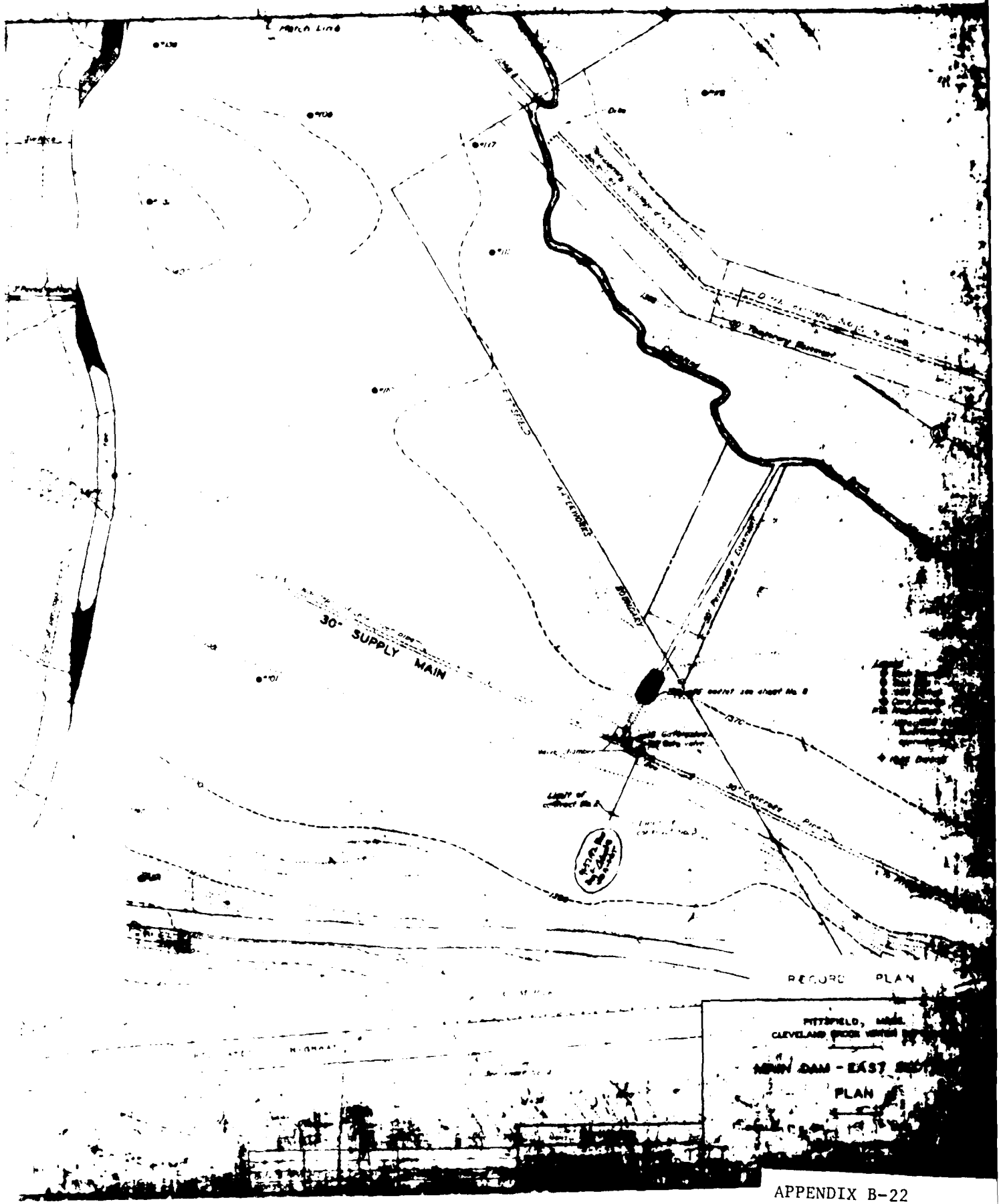
where Q = Discharge over spillway, c.f.s.
 C = Coefficient, 3.3 for flashboards vertical, 2.7 for flashboards horizontal
 L = Length of weir section in feet
 H = Head on weir in feet



PROFILE SHEETED CUT-OFF TRENCH

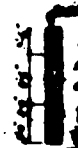






2

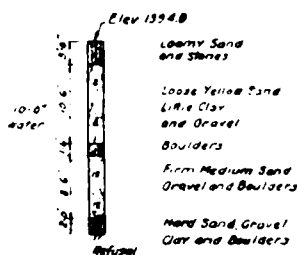
NO. 120



NO. 120



NO. 118



Note:
Indicates number of blows required to drive sampling pipe one foot unless otherwise noted. The weight of the sampler is 140 lb. weight falling 30'.

Note:
All borings were made by the Raymond Concrete Pipe Co. and unless otherwise noted, the wash borings were in November and December 1947.

Note:
Loss of wash water in any stratum indicated by * Absence of * indicates no water reported lost.

Note:
Test pits indicate formation containing considerable stone of varying sizes which leads to the conclusion that refusal shown on many borings may be due to casing striking relatively small pieces of rock.

118
Loam Sand
and Boulders
Firm
Medium
Sand
Gravel and
Boulders

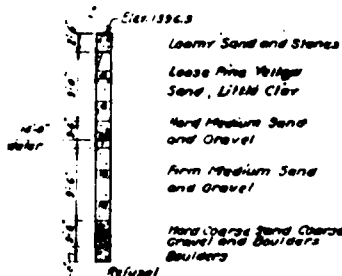
119
Loam Sand
and Boulders
Firm
Medium
Sand
Gravel and
Boulders
Hard
Sand, Gravel
Clay and
Boulders

TWEEN 390 FEET AND 1110 FEET WEST OF ROAD

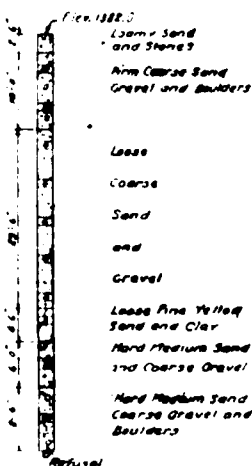
105

105
Loam Sand
and Boulders
Firm
Medium
Sand
Gravel and
Boulders

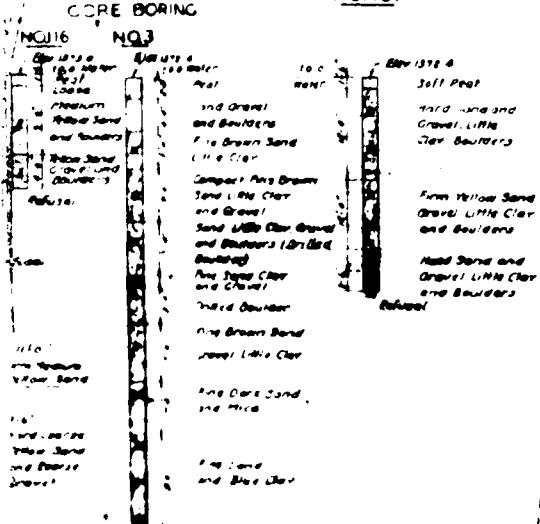
NO. 119



NO. 117



NO. 107



Note:
For location of borings see Sheet Nos. 1, 2, 3, & 3C

PITTSFIELD, MASS.
CLEVELAND BRICK WATER SYSTEM

BORINGS DATA

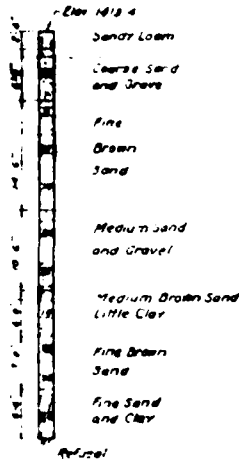
TWEEN 890 FEET AND 910 FEET WEST OF ROAD

2

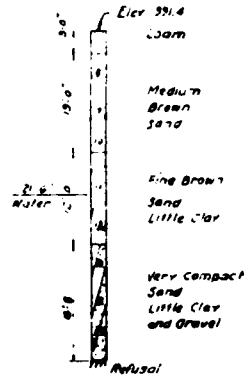


1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0

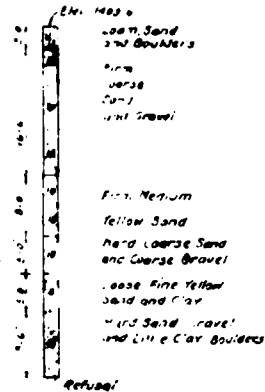
NO. 128



NO. 127



NO. 106



Note:
Indicates number of
to drive Sampling
unless otherwise
140 lb weight Pulling

Note:
All borings were made
Concrete Fly Co. and
noted are with hard
Hammer and Dec

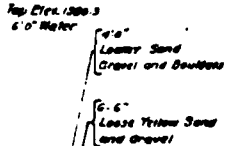
Note:
Loss of wash water
indicated by 0
indicates no water

Note:
Test pits indicate for
considerable stone
leads to the conch
shown on many
casing striking re
of rock.

BORINGS BETWEEN 990 FEET AND 1110 FEET

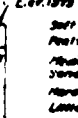
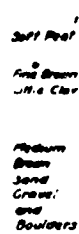
1000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0

NO. 105



1930 BORING NO. 5

NO. 126



NO. 129



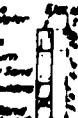
NO. 130



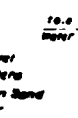
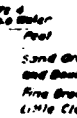
NO. 131



NO. 132



CORE BORING



1240
1230
1220
1210
1200
1190
1180
1170
1160
1150
1140
1130
1120
1110
1100
1090
1080
1070
1060
1050
1040
1030
1020
1010
1000
990
980
970
960
950
940
930
920
910
900
890
880
870
860
850
840
830
820
810
800
790
780
770
760
750
740
730
720
710
700
690
680
670
660
650
640
630
620
610
600
590
580
570
560
550
540
530
520
510
500
490
480
470
460
450
440
430
420
410
400
390
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

BORINGS BETWEEN 690 FEET AND 990 FEET

NO. 122

NO. 114

Fig. 411 B

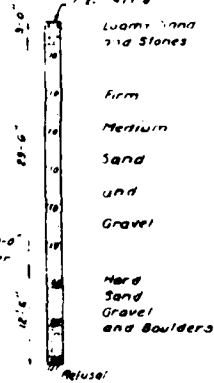
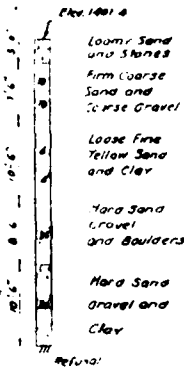
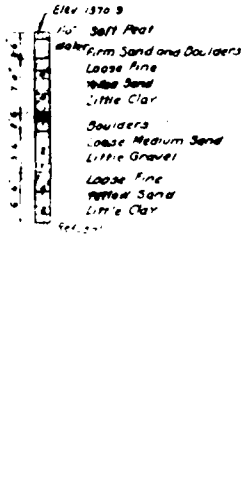
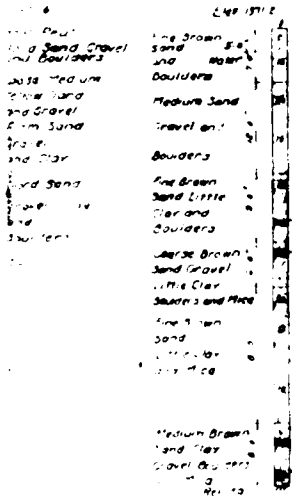
Note
Test pits indicate formation containing considerable stone of varying sizes, which leads to the conclusion that refusal in many borings may be due to casing striking relatively small pieces of rock.

Note
All borings were made by the Richmond Concrete Paving Co. and unless otherwise stated are all borings made in accordance with the specifications of the City of Pittsfield, Mass., dated November 1, 1917.

LAKE BORING

NO. 47

NO. 113



BETWEEN 705 FEET AND 800 FEET WEST OF ROAD

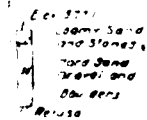
NO. 109

NO. 112

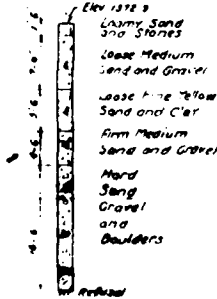
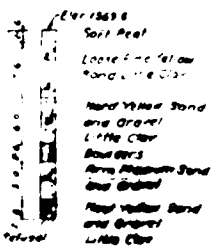
LOCATION PLAN

SCALE 1"=200'

LEGEND
 • Wash Borings
 - Test Pits
 + 1930 Borings
 x Core Borings
 --- Stone Walls
 --- Fences
 --- Road
 o 1941 Borings



NO. 137



Note
For location of borings see also Sheet Nos. 1, 2, 3

RECORD PLAN

PITTSFIELD, MASS.
CLEVELAND BROOK WATER SUPPLY

BORING DATA

SCALE - AS SHOWN

RECEIVED BY
ENGINEER
PITTSFIELD, MASS.

BETWEEN 500 FEET AND 600 FEET WEST OF ROAD

APPROVED	
FOR REVIEW BY	FOR REVIEW BY
DATE	DATE
SIGNED	SIGNED

APPENDIX B-28

2

410

400

390

380

370

360

350

340

330

320

310

300

290

280

270

260

250

240

230

220

210

200

Note
Indicates number of blows required
to drive sampling pipe one foot
unless otherwise indicated using
140 lb weight falling 30"

Note
Loss of wash water in any situation
indicated by * Absence of *
indicates no water reported lost

Note
All borings were made by the Raymond
Concrete Pile Co. and unless otherwise
noted are wash borings made in
November and December 1947

CORE BORING

NO. 125

NO. 140

NO. 134

NO. 108

NO. 4

NO. 113

Elev. 376.1
Laminar and Boulders
Coarse Brown
Sand and Gravel
Little Clay
Fine Brown Sand
Little Clay
Decomposed Rock
Refusal

Elev. 374.7
Loose Sand
and Shells
Loose Fine
Yellow Sand
Little Clay
Hard Sand
Gravel and
Boulders
Loose Yellow
Sand
Little Clay
Hard Sand
Gravel and
Clay
Boulders
Refusal

Elev. 372.7
Peat
Loose Fine Yellow Sand
Gravel and Little Clay
Firm Medium Yellow
Sand and Gravel
Boulders
Hard
Sand
Gravel
and Clay

Elev. 371.6
Soft Peat
Hard Sand Gravel
and Boulders
Loose Medium
Yellow Sand
and Gravel
Firm Sand
Gravel
and Clay
Hard Sand
Gravel Clay
and Boulders
Refusal

Elev. 371.2
Fine Brown
Sand and
Boulders
Medium Sand
Gravel and
Boulders
Fine Brown
Sand Little
Clay and
Boulders
Coarse Brown
Sand Gravel
Little Clay
Boulders and
Mica
Fine Brown
Sand
Little Clay
and Mica

Elev. 370.9
Soft Peat
Firm Sand
Loose Fine
Yellow Sand
Little Clay
Boulders
Loose Red
Little Clay
Loose Fine
Yellow Sand
Little Clay
Refusal

Medium Brown
Sand Clay
Gravel Boulders
and Mica
Refusal

BORINGS BETWEEN 705 FEET AND 800 FEET WEST

1930 BORING

WASH AND CORE BORING

NO. 133

NO. 4

Elev. 380.0
Loose Sand
Gravel and
Boulders
Coarse Sand
and Gravel
Little Clay
Very Compact
Sand and Gravel
Little Clay
Refusal

Elev. 378.2
Hard Fine Sand
and Boulders
Sand Gravel Little
Clay and Boulders
Coarse Sand
Gravel
and Boulders
Boulder
Medium Sand
Coarse Gravel
and Boulders

NO. 138

NO. 109

NO. 137

Elev. 376.6
Loose Sand
and Shells
Hard Fine
Sand Gravel
and Boulders
Firm Loose
Sand Gravel
and Boulders
Hard Sand Gravel
Clay and Boulders
Refusal

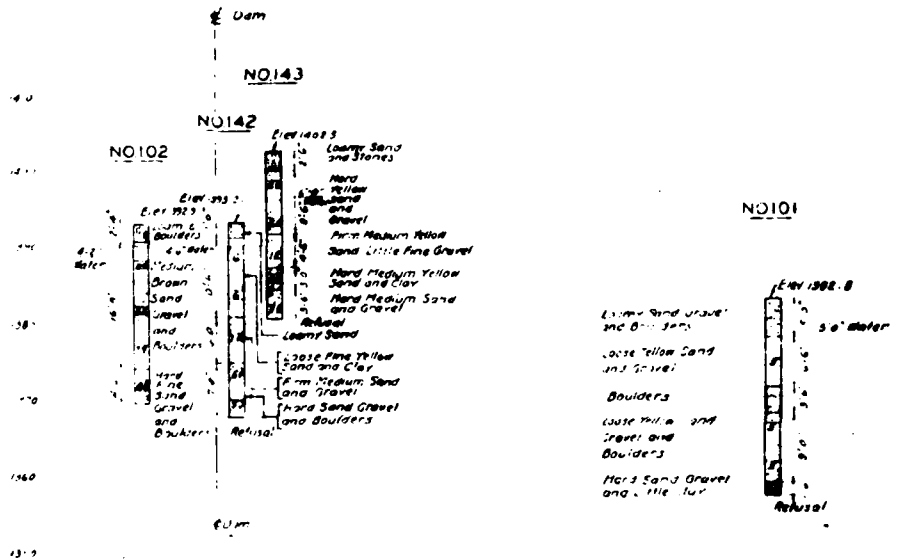
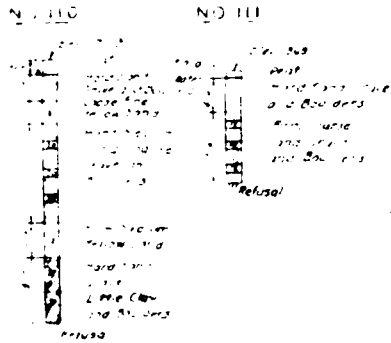
Elev. 377.1
Loose Sand
and Shells
Hard Sand
Gravel and
Boulders
Refusal

Elev. 363.6
Soft Peat
Loose Fine Yellow
Sand Little Clay
Hard Yellow Sand
and Gravel
Little Clay
Boulders
Firm Medium Sand
and Gravel
Hard Yellow Sand
and Gravel
Little Clay
Refusal

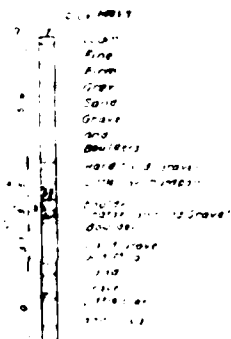
BORINGS BETWEEN 550 FEET AND 600 FEET WEST

Note
All borings were made with the following
Concrete Pipe (C) and unless there is
noted are wash borings, made in
November and December 1947

Note
Test pits indicate formation containing
considerable stone of varying sizes, which
leads to the conclusion that refusal
shown on many borings may be due to
casing strike and not to small pieces
of rock.



1930 BORING
WASH AND CORE BORING
NO3A



BORINGS BETWEEN 90 FEET AND 230 FEET WEST OF ROAD

Note
Indicates the number of blows required
to drive sampling pipe one foot, unless
otherwise indicated. Sample weight
falling 30"

Note
Loss of wash water in any stratum
indicated by *. Absence of *
indicates no water reported lost

Note
For location of borings see Sheet
"NO 1" 2, 3, 4, 5

PITTSFIELD, MASS
CLEVELAND BROOK WATER SUPPLY

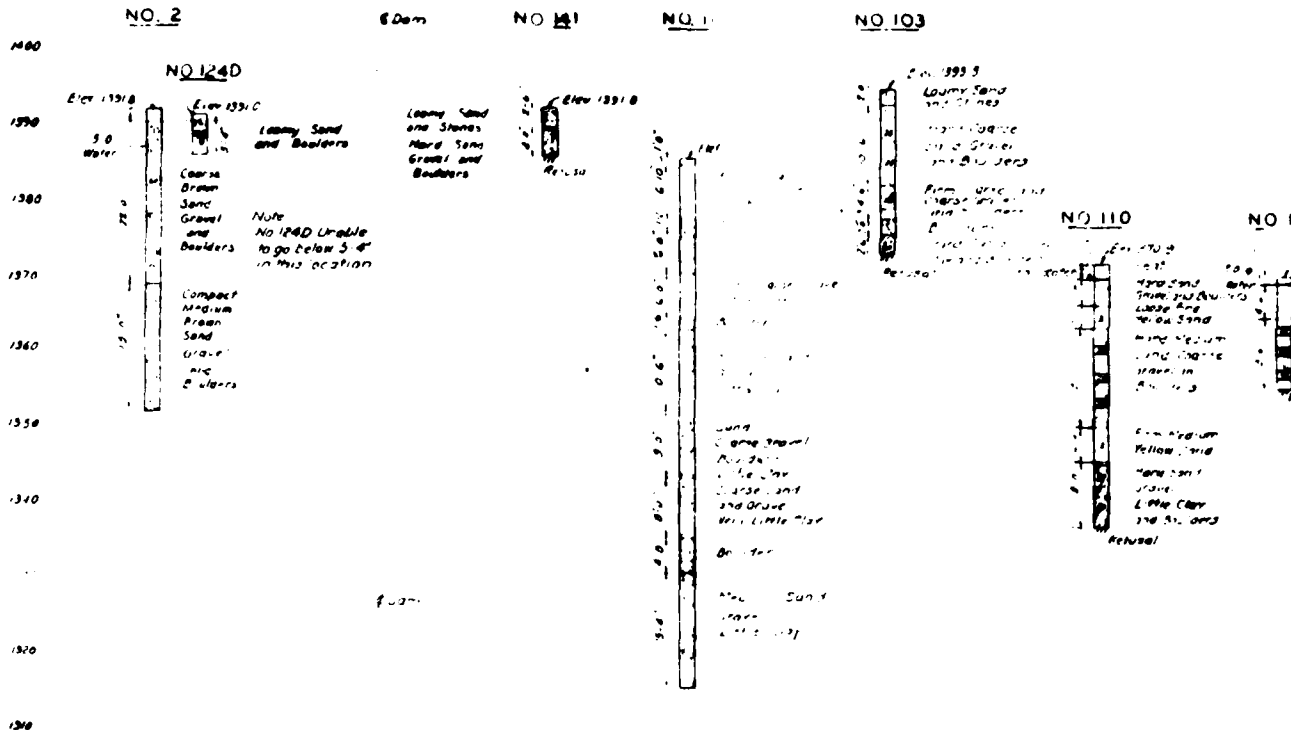
BORING DATA

SCALE - AS SHOWN MAY 1948

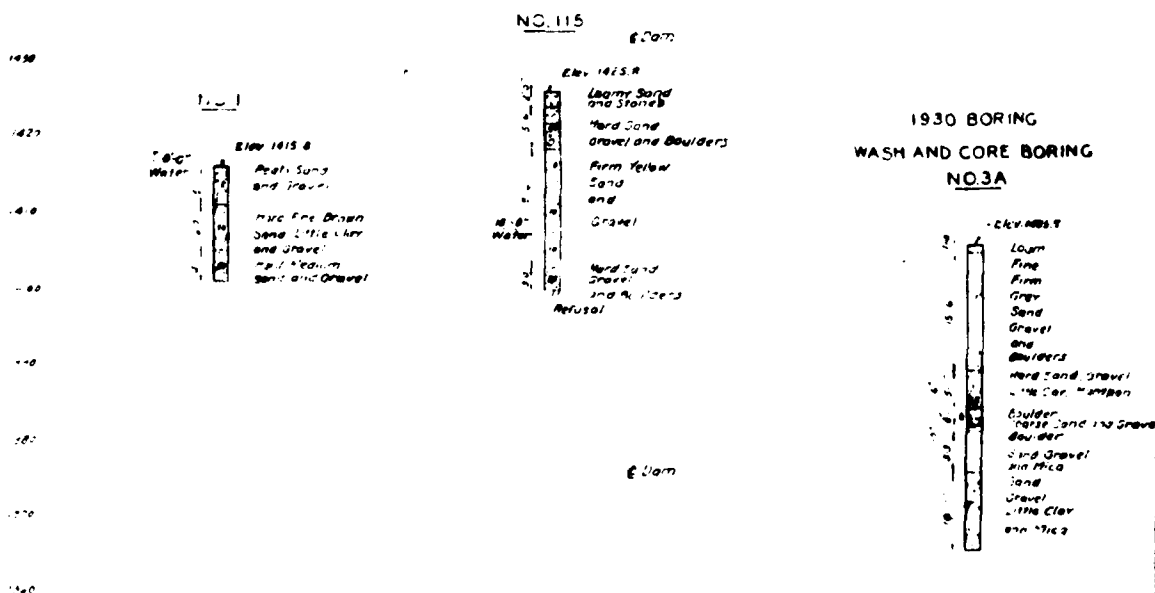
NETCALP & SONS
ENGINEERS
BOSTON, MASS.

APPROVED
FOR NETCALP & SONS, ENGINEERS
SEA PEEK ROAD, BARK, MA 70

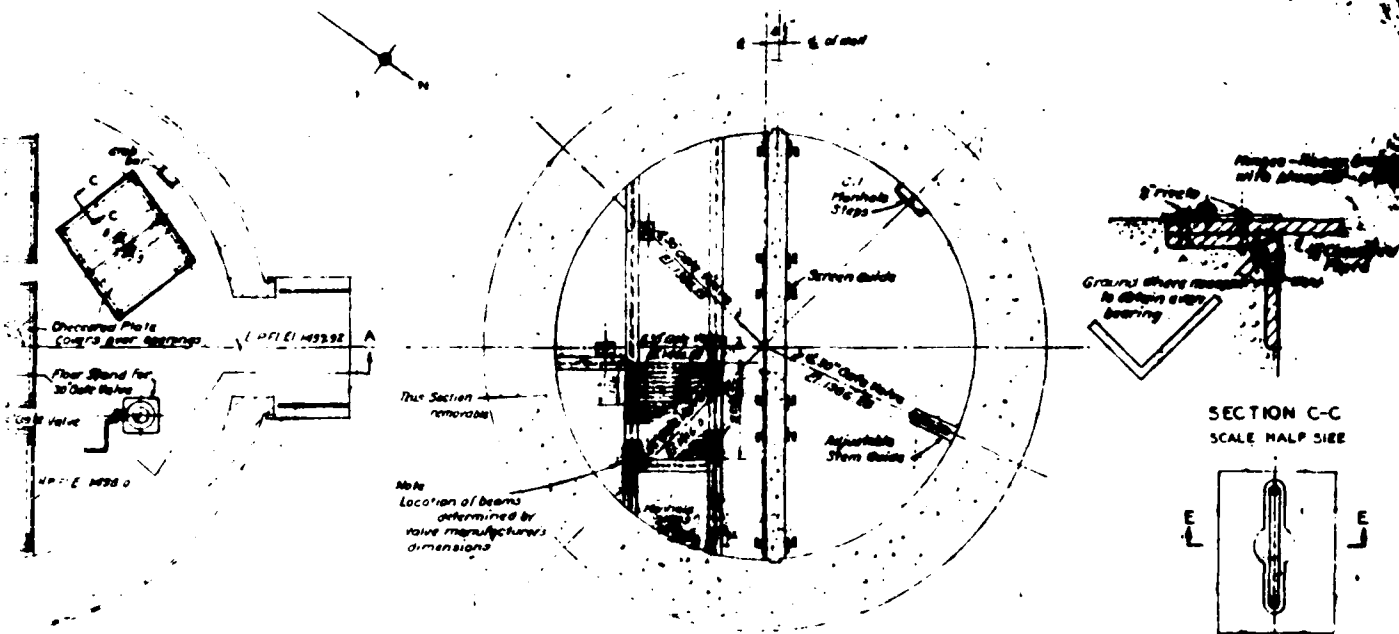
CORE BORING
NO. 2



NC. 115

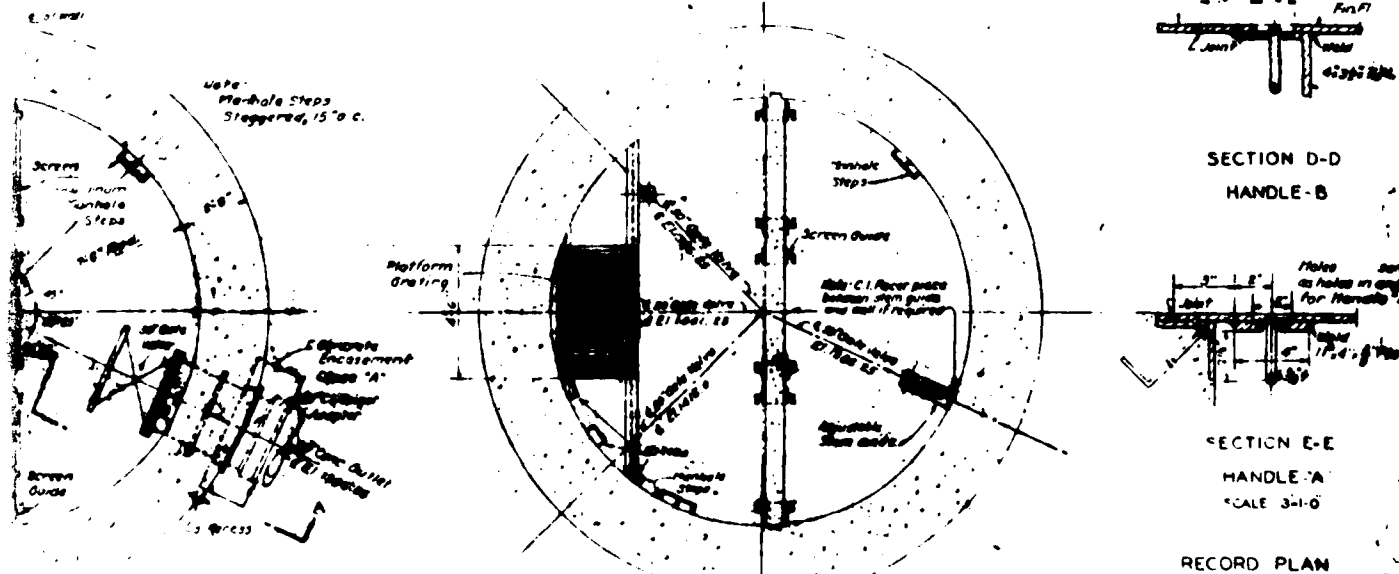


BORINGS BETWEEN 5.5 FEET EAST AND 10 FEET WEST OF E ROAD



OR PLAN

PLAN AT ELEVATION 1413.0

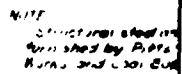


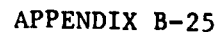
LAN B-B

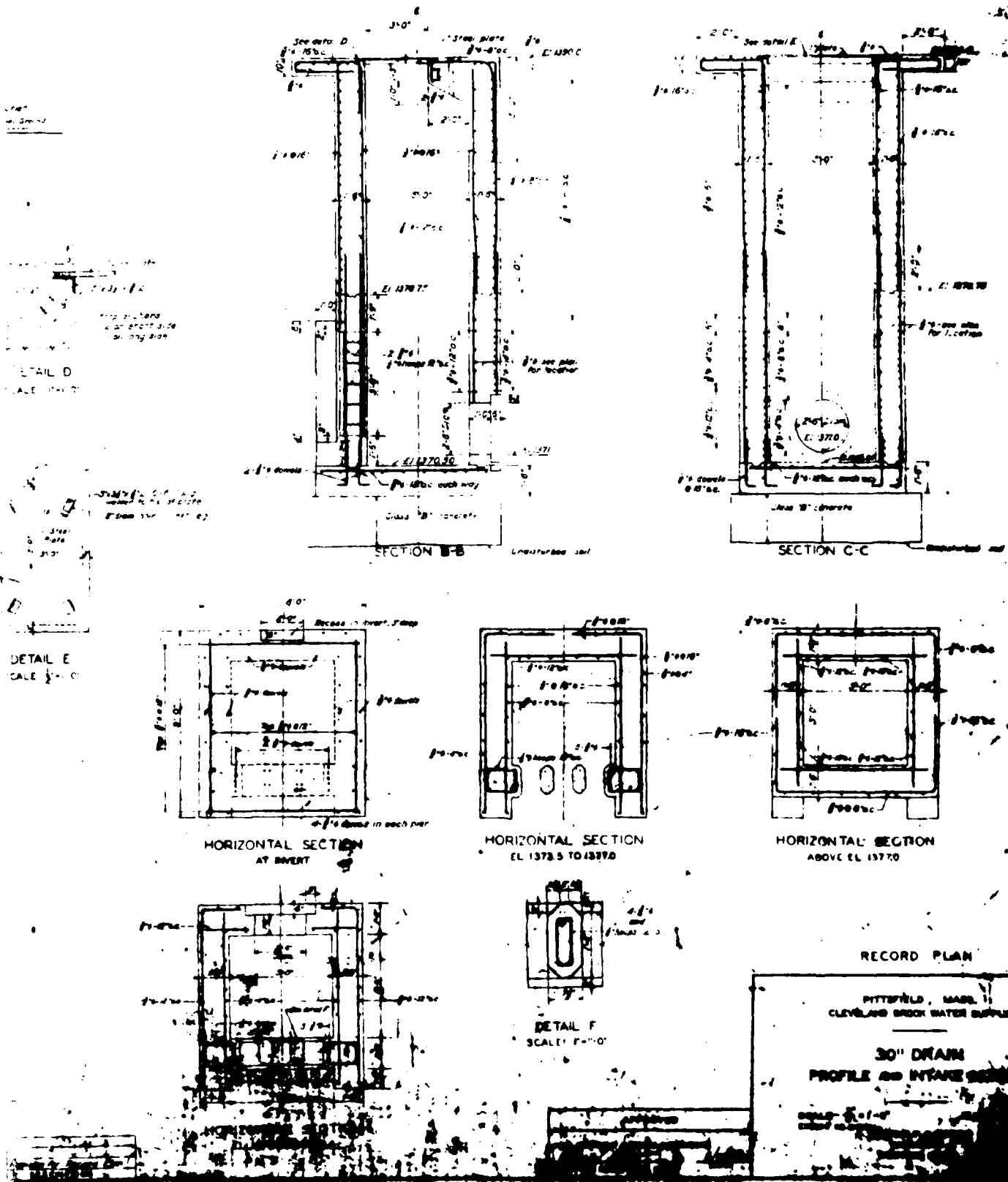
PLAN AT ELEVATION 1386.0

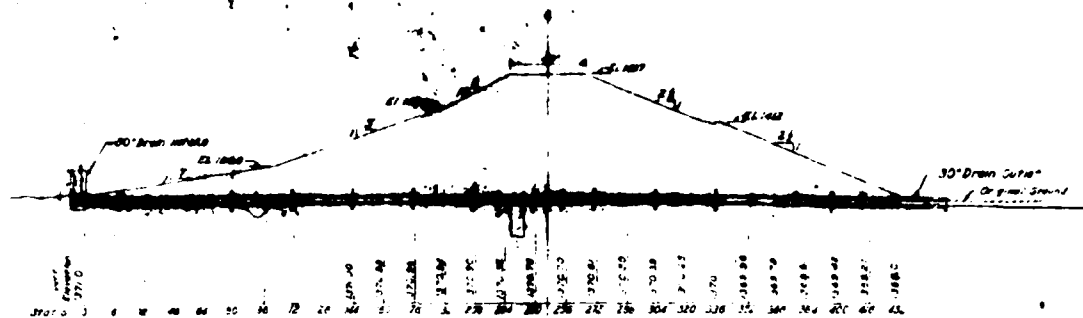
PITTSFIELD, MASS.
CLEVELAND BROOK WATER SUPPLY

GATE STRUCTURE
MECHANICAL DETAILS

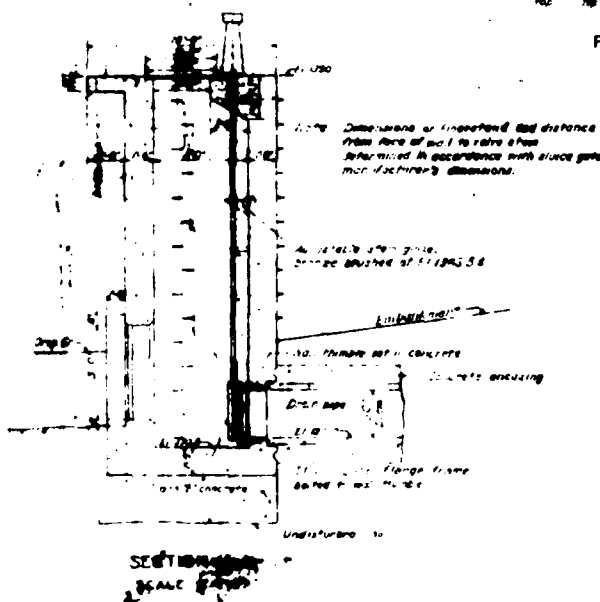
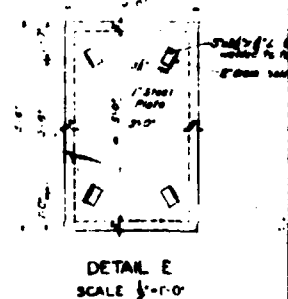
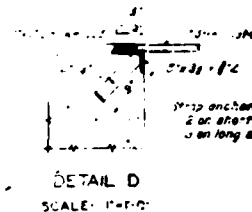
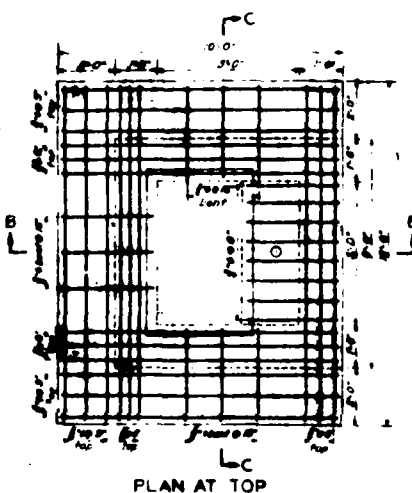
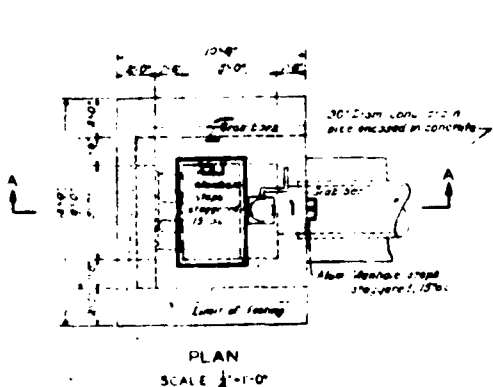






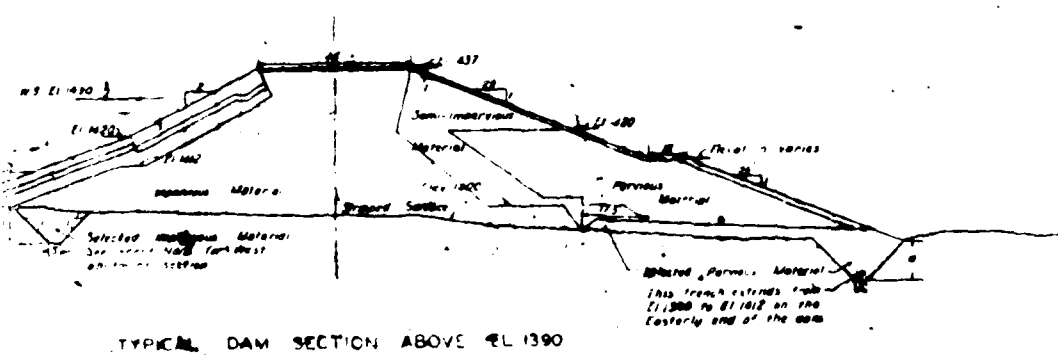
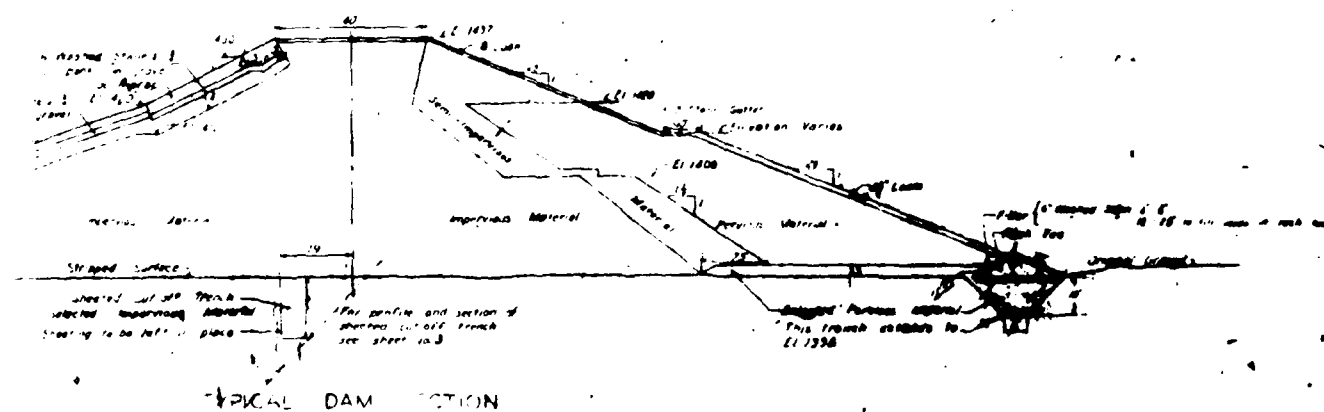
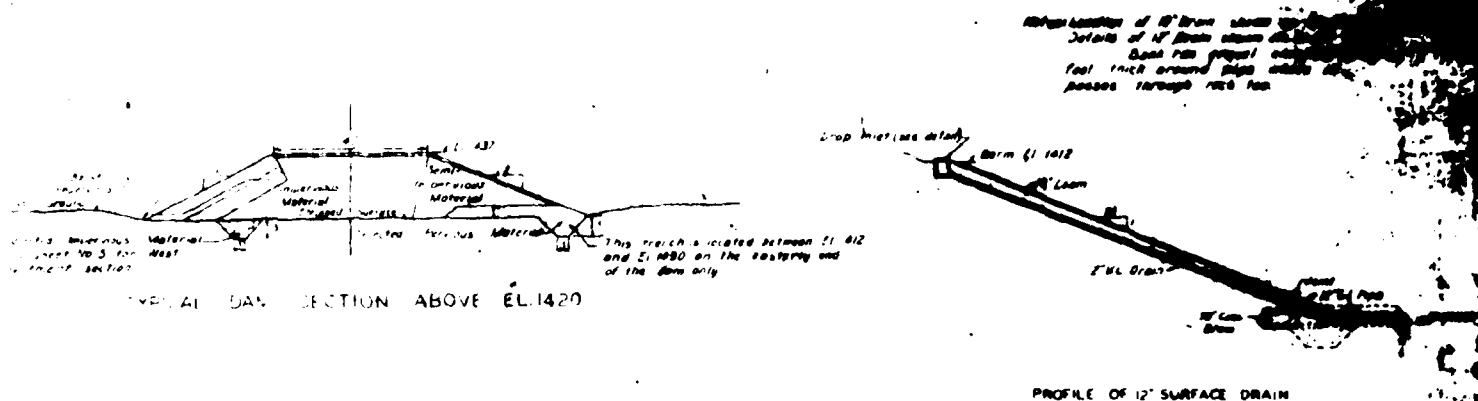


DAM SECTION ALONG 30° DRAIN
SCALE 1"=40'



DESIGNED BY A. P. J.
CHECKED BY E. A. J.
APPROVED BY E. A. J.

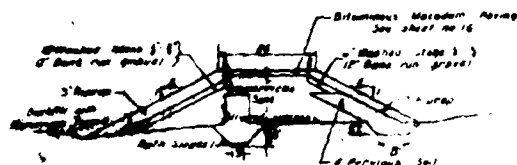
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---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----



RECORD PLAN 254

PITTSFIELD, MASS.
CLEVELAND ENGINE WATER SUPPLY

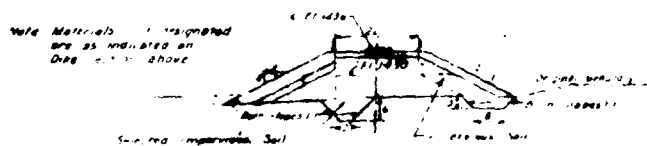
**DAM AND DIKE
TYPICAL SECTION**



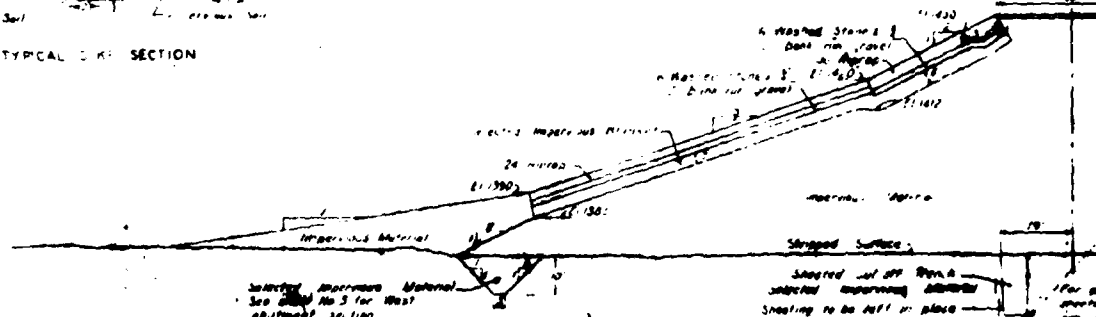
TYPICAL DIKE SECTION NEAR PIPE LINE CROSSING



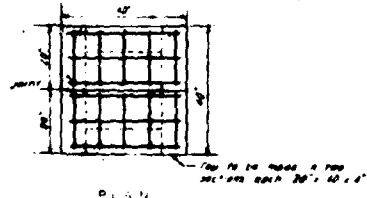
TYPICAL DAM SECTION



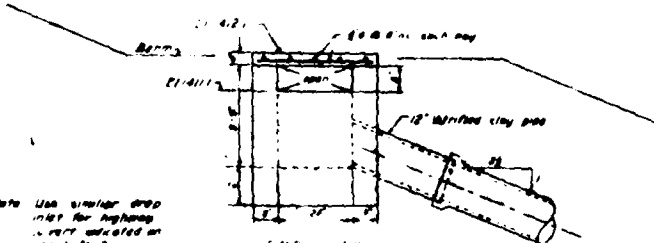
TYPICAL DIKE SECTION



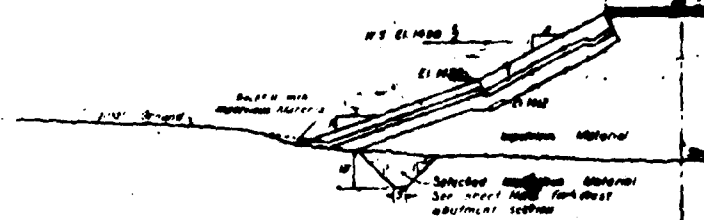
TYPICAL DAM



PLAN

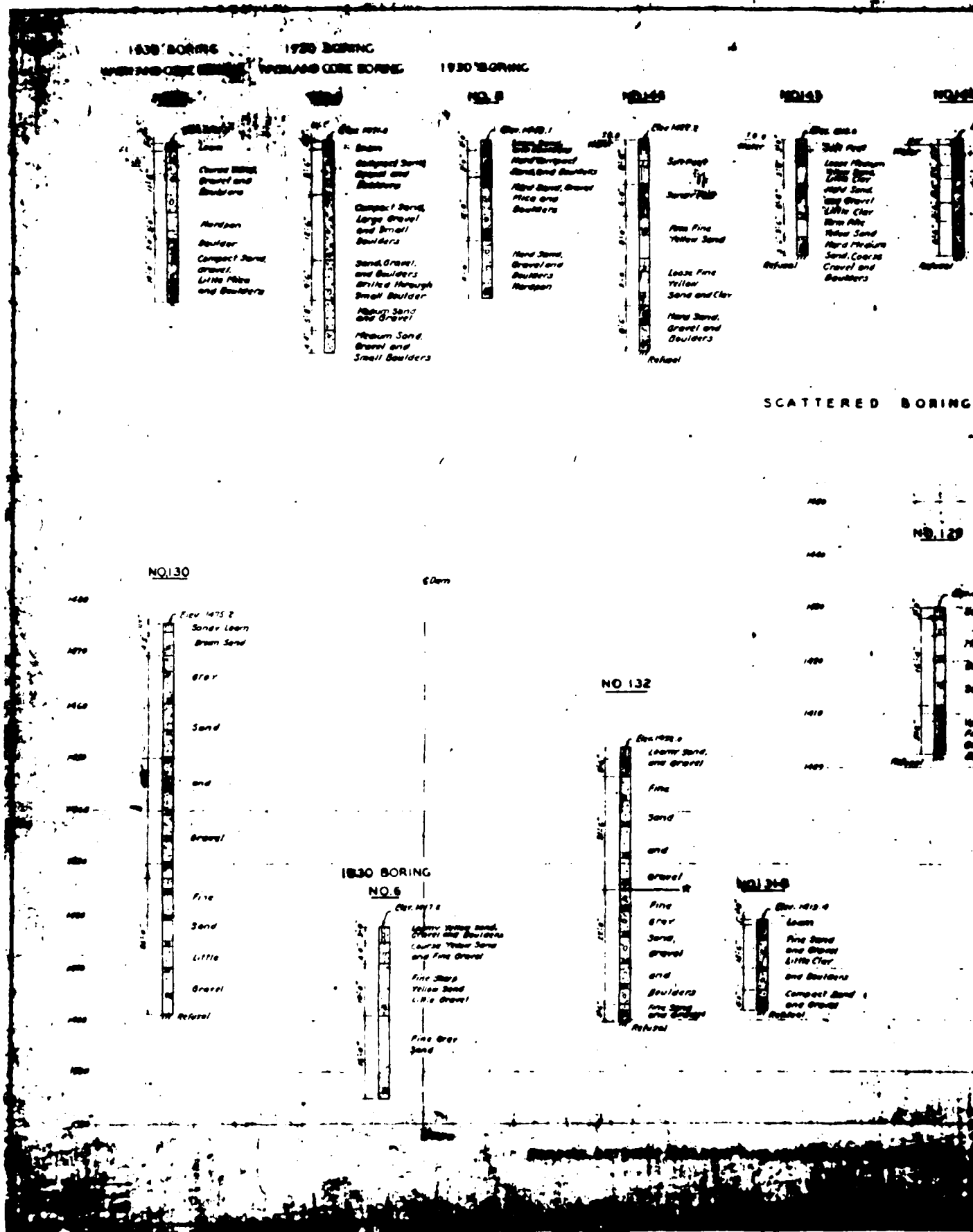


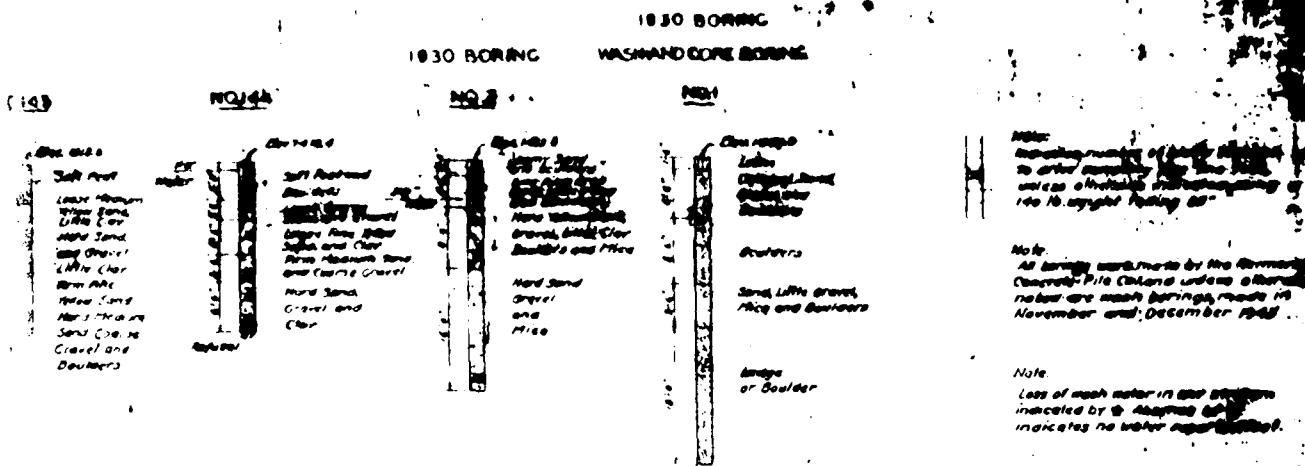
DROP INLET
STA. 9+70
SCALE 1"=10'



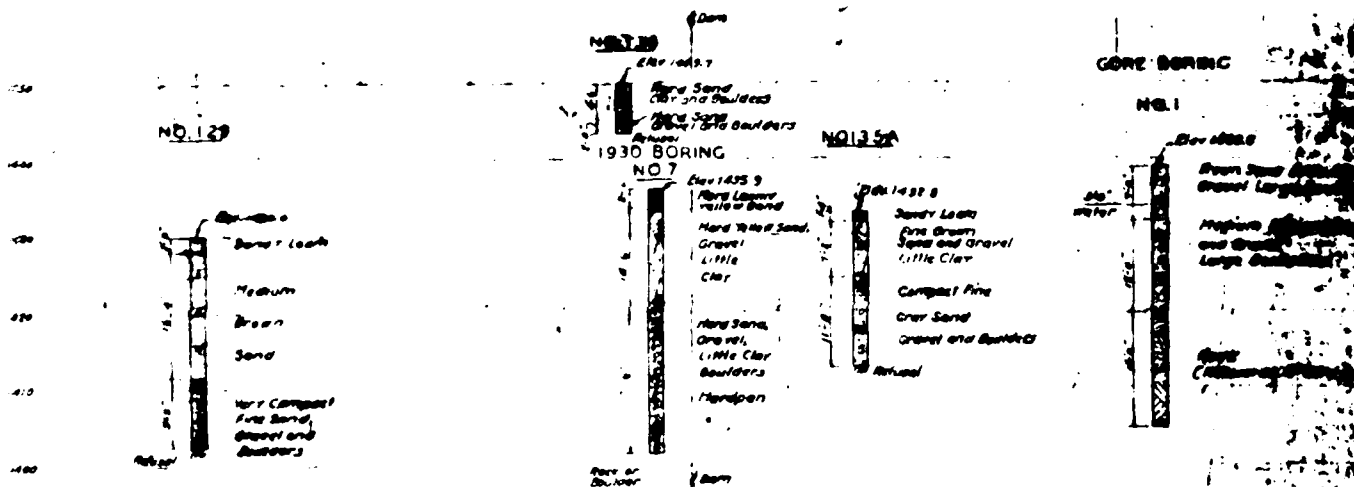
TYPICAL DAM SECTION

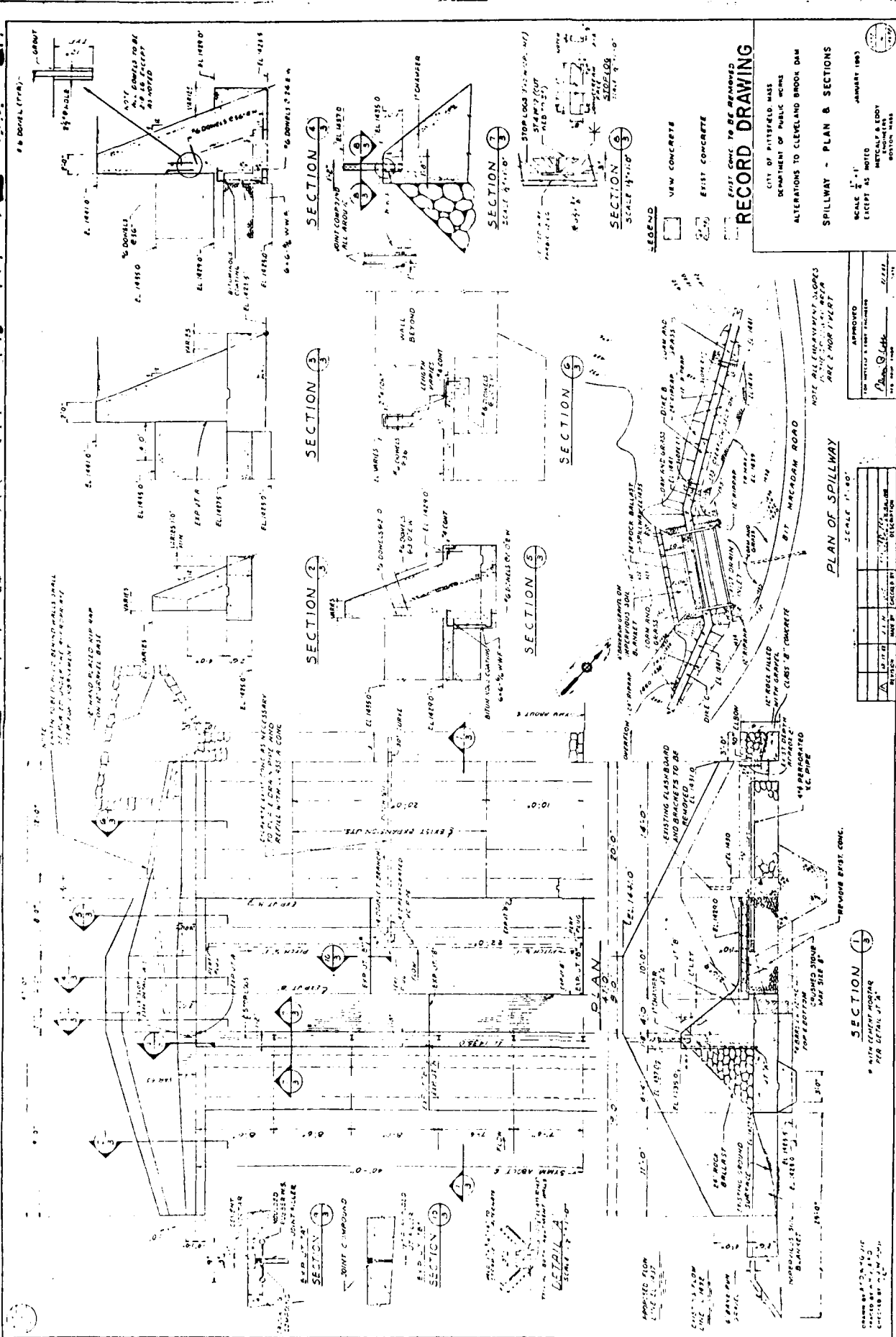
Drawn by: JRE
Checked by: JRE
Scale: 1"=10'





ATTERED BORINGS - EAST OF ROAD





(CITY OF PITTSFIELD, MASS
DEPARTMENT OF PUBLIC WORKS
ALTERNATIONS TO CLEVELAND BROOK DAM
DIRE A - PLAN & PROFILE
COLLAPSIBLE FLASH-BOARDS
DETAILS & SECTION
SCALE AS SHOWN
JANUARY 1963
METCALF & EDDY
ENGINEERS
PITTSFIELD, MASS
CONTRACT 195.2
SHEET 4 OF 4

[illegible]

CONTRACT 1963 2 SWEET & DOW

July 26, 1976

Subject WATERWAYS-District One
Hinsdale Cleveland Reservoir
Dam No. 1-2-132-4

Mr. John Bartels, Chairman
Board of Selectmen
Dalton, MA 01226

Dear Sir

In answer to your letter of July 20, 1976 requesting information concerning the condition of the subject dam, we enclose a copy of the inspection report submitted to Boston Waterways in November, 1975. Please note that this report is of an advisory nature, and does not indicate an emergency situation.

The Pittsfield Water Department and District One personnel monitored the flow throughout the winter and spring of 1975-1976. No increase in flow was noted. Dye tests performed by consulting engineers were negative. This strengthened our belief that the flow is a spring and not a leak.

However, as we originally stated in the report, the size and location of this structure warrants an in depth investigation of the condition. Not until an investigation is completed can anyone absolutely determine the true nature of this matter.

If we can be of further assistance, please contact the District One office.

Very truly yours

Dean P. Amidon

Dean P. Amidon, P. E.
District Highway Engineer

RDJ:mif

Enclosure

cc J. J. Hannon ✓
Chief Engineer, DEQE
SurvLen

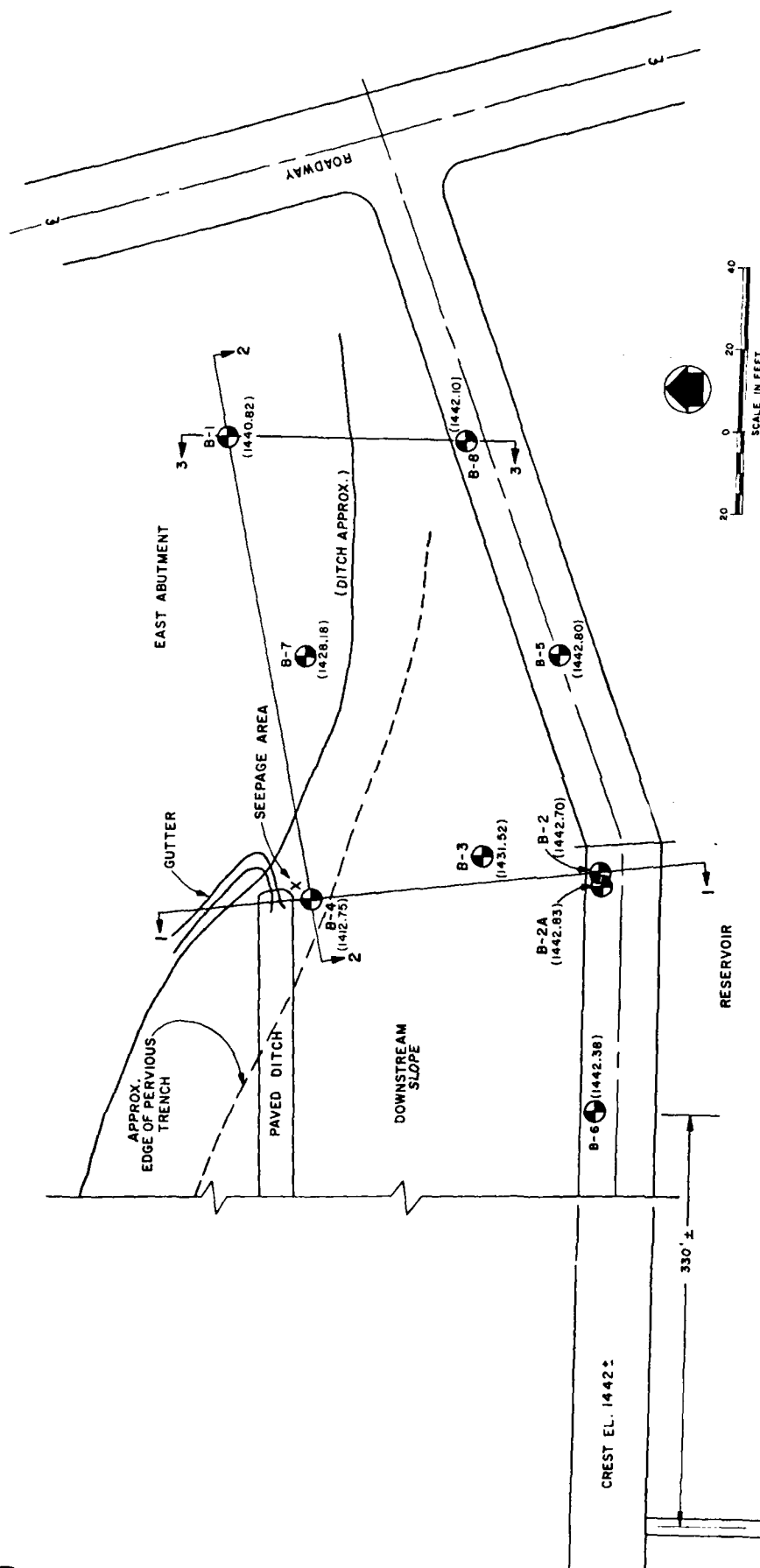


FIG. E-1 PLAN OF BORING LOCATIONS

METCALF & EDDY

(1963)
GATE STRUCTURE
FLOOR EL. 1438 ±

TABLE 1. RESULTS OF INSITU FALLING HEAD PERMEABILITY TESTS

Perm No.	Boring	Depth (ft.)	Elevation (ft.)	Permeability coefficient k cm/sec		Unified soil classification(1)	Blows/6" Interval	Comments
				Initial	Final Assumed			
1	B-1	37.5	1,403.30	6x10 ⁻⁴	5x10 ⁻⁴	SM	22-36-69-78	Foundation soil (abutment)
2	B-2	24.0	1,418.70	4x10 ⁻⁴	1x10 ⁻⁴	SM	29-64-46-32	Embankment soil (core)
3	B-2	30.0	1,412.82	2x10 ⁻³	2x10 ⁻³	SM	22-34-40-118	Embankment soil (near contact surface)
4	B-3	16.0	1,415.44	3x10 ⁻⁴	2x10 ⁻⁴	SP-SM	19-16-37-29	Embankment soil (semi- impervious zone)
5	B-3	20.0	1,411.44	6x10 ⁻⁴	4x10 ⁻⁴	SM	1-4-20-24	Foundation soil (near contact surface)
6	B-4	6.0	1,406.75	2x10 ⁻²	5x10 ⁻³	SP-SM	3-3-4-3	Within pervious toe
7	B-4	8.0	1,404.75	2x10 ⁻²	9x10 ⁻³	SM	3-3-3-40	Apparent contact (toe and foundation soil)
8	B-4	18.0	1,394.75	1x10 ⁻²	1x10 ⁻²	SM	7-9-14-20	Foundation soil
9	B-5	24.0	1,418.80	3x10 ⁻³	1x10 ⁻³	SP-SM	34-29-28-32	Foundation soil
10	B-5	28.0	1,414.80	3x10 ⁻³	2x10 ⁻³	SP-SM	22-12-12-17	Foundation soil
11	B-6	22.0	1,420.38	-	-	SM	13-14-17-28	Embankment soil (core)
12	B-6	30.0	1,412.38	2x10 ⁻³	3x10 ⁻⁴	GP-SM	37-51-63-79	Embankment soil (core)
13	B-7	20.0	1,408.18	2x10 ⁻³	1x10 ⁻³	SP-SM	9-12-15-17	Foundation soil
14	B-7	25.0	1,403.18	1x10 ⁻³	-	SP-SM	27-31	Foundation soil
15	B-8	15.0	1,427.25	2x10 ⁻⁴	1x10 ⁻⁴	SM	29-46-52-35	Foundation soil
16	B-8	21.0	1,421.25	2x10 ⁻³	1x10 ⁻³	SM	12-11-11-10	Foundation soil
17	B-8	27.0	1,415.25	6x10 ⁻³	3x10 ⁻³	No sample	14-11-10-9	Foundation soil
18	B-8	35.0	1,407.25	1x10 ⁻³	-	SM	19-20-56-33	Foundation soil

1. SM - silty sand.

SF-SM - Poorly graded silty sand.

GP-GM - Poorly graded silty gravel.

TABLE 2. PIEZOMETERS - LOCATIONS AND WATER LEVEL MEASUREMENTS

Boring	Piez. No.	Date Installed	Tip El. (ft.)	Water elevations in piezometers									
				Date = 9/16/76	9/17/76	9/18/76	9/19/76	9/20/76	9/21/76	9/22/76	9/23/76	9/24/76	9/25/76
				Res. El. = 1,429.27	1,429.15	1,425.85	1,428.75	1,428.00	1,427.00	1,427.90	1,427.90	1,427.90	1,429.50
3	P-1	9/10/76	1,401.94	1,421.12	1,424.07	1,421.62	1,421.12	1,421.12	1,421.02	1,420.02	1,420.22	1,420.22	1,420.22
3	P-2	9/10/76	1,411.94	1,421.22	1,423.72	1,420.82	1,421.42	1,421.42	1,420.32	1,420.07	1,420.47	1,420.47	1,420.47
3	P-3	9/13/76	1,421.44	1,422.00	1,422.02	Dry	1,421.72	Dry	Dry	Dry	Dry	Dry	Dry
4	P-4	9/14/76	1,397.75	-	1,409.35	1,406.95	1,405.90	1,408.75	1,408.35	1,408.35	1,408.35	1,408.35	1,408.35
4	P-5	9/14/76	1,405.75	-	1,411.70	1,409.35	1,411.60	1,411.45	1,411.12	1,411.12	1,410.75	1,410.75	1,410.75
2A	P-6	9/16/76	1,402.02	-	1,420.76	1,420.45	1,420.75	1,419.95	1,419.80	1,419.80	1,420.25	1,420.25	1,420.25
2A	P-7	9/16/76	1,407.32	-	1,422.71	1,422.95	1,422.75	1,421.95	1,422.95	1,422.95	1,421.95	1,421.95	1,421.95
2	P-8	9/16/76	1,411.90	-	1,423.48	1,423.48	1,423.56	1,421.18	1,422.68	1,422.68	1,422.38	1,422.38	1,422.38
2	P-9	9/16/76	1,421.40	-	1,423.48	1,423.58	1,422.38	1,422.08	1,421.78	1,421.78	1,422.28	1,422.28	1,422.28
7	P-10	9/16/76	1,410.18	-	1,421.15	1,420.48	1,420.78	1,416.38	1,422.38	1,422.38	1,420.08	1,420.08	1,420.08
8	P-11	9/20/76	1,410.10	-	-	-	Plugged	Plugged	Plugged	Plugged	Plugged	Plugged	Plugged
8	P-12	9/20/76	1,420.74	-	-	-	1,423.49	1,421.19	1,421.94	1,421.94	1,422.19	1,422.19	1,422.19
8	P-13	9/20/76	1,427.10	-	-	-	Dry	Dry	Dry	Dry	Dry	Dry	Dry
1	P-14	9/21/76	1,411.25	-	-	-	-	-	1,418.45	1,419.75	1,419.45	1,419.45	1,419.45
1	P-15	9/21/76	1,422.12	-	-	-	-	-	Dry	Dry	Dry	Dry	Dry

CLIENT: Metcalf & Eddy, Inc.		General Borings, Inc.		SHEET 1 OF 2	
		P. O. BOX 7135 PROSPECT, CONN. 06712		HOLE NO. B-1	
CONTRACTOR GBI #723		PROJECT NAME Cleveland Brook Reservoir Dam		LINE	
FOREMAN-DRILLER D.T. E.P.		LOCATION Hinsdale, Massachusetts		STATION	
INSPECTOR R.W.				OFFSET	
GROUND WATER OBSERVATIONS AT 18.75 FT. AFTER 0 HOURS		TYPE HW		Casing 4"	
AT 19.25 FT. AFTER 16 HOURS		SAMPLER SS		CORE BAR. NX	
		SIZE I.D. 4"		3" 2 1/8"	
		HAMMER WT. 300 LBS.		BIT 18"	
		HAMMER FALL		DATE 9/7 9/9/76	
				SURFACE ELEV.	
				GROUND WATER ELEV.	

DEPTH	CASING BLOWS PER FOOT	SAMPLE				BLOWS PER 6" ON SAMPLER (FORCE ON TUBE)	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST.	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO.	TYPE	PEN.	REC.					
5		1	ss	18"	14"	1.5'	2 4 7	dry	1.0'	1) Topsoil - brown fine-medium sand, trace coarse gravel.
		2	ss	18"	14"	3.0'	8 10 9	medium		2) Brown fine-medium sand, trace silt, trace fine gravel.
		3	ss	18"	8"	4.5'	6 6 7	"	6.0'	3) Same as sample #2.
		4	ss	18"	10"	6.0'	4 6 5	"		4) Same as sample #2.
10		5	ss	18"	9"	7.5'	16 29 31	dry very dense		5) Brown-orange-gray fine-medium sand, trace coarse sand, trace fine gravel, trace silt, trace fractured rock.
		6	ss	18"	14"	9.0'	32 56 59	"		6) Brown-gray fine-medium sand, trace silt, little rock fragments, trace coarse gravel.
15		7	ss	18"	18"	10.5'	36 74 110	moist very dense		7) Same as sample #6.
		8	ss	9"	6"	11.5'	64 150/3"	"		8) Gray coarse-fine sand, some coarse-fine gravel. (Refusal on spoon at 11.25') Corer 6' boulder, cored 11.25'-13.0'.
		9	ss	18"	10"	14.5'	14 16 13	moist med.		9) Gray-brown fine sand, little silt, some fine-medium gravel.
20		10	ss	18"	12"	16.0'	11 31 16	moist dense		10) Same as sample #9.
		11	ss	18"	14"	17.5'	12 22 24	"		11) Same as sample #9, some coarse sand.
25		12	ss	24"	4"	19.5'	13 14 14 16	"		12) Same as sample #11, coarse gravel in spoon tip.
		13	ss	24"	5"	21.5'	16 13 26 14	"		13) Gray-brown fine-medium sand, little silt, some fine-medium gravel.
30		14	ss	24"	14"	23.5'	31 46 14 32	"		14) Brown coarse-fine sand, medium-fine gravel, trace silt.
		15	C	36"	27"	26.5'	CORED			NOTE: Refusal at 23.5' corer boulder 23.5'-26.5', recovered 2.25'.
35		16	ss	24"	16"	31.0'	21 26 31 37	moist dense		15) Brown fine sand, little silt, trace fine gravel.
		17	ss	24"	18"	33.0'	31 42 46 53	"		NOTE: Drilled cobble 23.5'-26.5'.
40		18	ss	24"	10"	37.75'	62 100 3"	"		16) Same as sample #15.
		19	ss	24"	7"	40.25'	56 150	"		17) Same as sample #15, little coarse gravel.

TYPE OF SAMPLES:				TOTAL FOOTAGE	
D=DRY	W=WASHED	C=CORED	A=AUGER	UP=UNDISTURBED PISTON	EARTH BORING _____ FT.
UB=UNDISTURBED BALL CHECK				VT=VANE TEST	ROCK CORING _____ FT.
PROPORTIONS USED					
TRACE=0-10%		LITTLE=10-20%	SOME=20-36%, AND=35-50%		

[illegible]

CLIENT: <u>Metcalf & Eddy, Inc.</u>		General Borings, Inc.		SHEET <u>Redrilled</u> OF <u> </u>									
		P. O. BOX 7135 PROSPECT, CONN. 06712		HOLE NO. <u>B-1</u>									
CONTRACTOR <u>GBI #723</u>		PROJECT NAME <u>Cleveland Brook Reservoir Dam</u>		LINE <u> </u>									
DREMAN-DRILLER <u>F.C. B.C.</u>		LOCATION <u>Minsdale, Massachusetts</u>		STATION <u> </u>									
INSPECTOR <u> </u>				OFFSET <u> </u>									
GROUND WATER OBSERVATIONS		CASING	SAMPLER	CORE BAR.	DATE <u>9/21/76</u>								
AT <u> </u> FT. AFTER <u> </u> HOURS		TYPE <u>HW</u>			Start <u> </u> Finish <u> </u>								
AT <u> </u> FT. AFTER <u> </u> HOURS		SIZE I.D. <u>1.75"</u>			SURFACE ELEV. <u> </u>								
		HAMMER WT. <u> </u> LBS.	BIT <u> </u>		GROUND WATER ELEV. <u> </u>								
		HAMMER FALL <u> </u>											
DEPTH	CASING BLOWS PER FOOT	SAMPLE				DEPTH # BOT.	BLOWS PER 6" ON SAMPLER FORCE ON TUBE			CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO.	TYPE	PEN	REC.		0-6	6-12	12-18				
5													Ran casing to 31.5' to install Piezometers. 1st 30.6' 2nd 18.7'
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100													

TYPE OF SAMPLES:
 D-DRY W-WASHED C-CORDED A-AUGER UP-UNDISTURBED PISTON
 UB-UNDISTURBED BALL CHECK VT-VANE TEST
 PROPORTIONS USED TRACE <10% 10-20% 20-35% 35-60%

TOTAL FOOTAGE
 EARTH BORING FT.
 ROCK CORING FT.

CLIENT: Metcalf & Eddy, Inc.				General Borings, Inc.				SHEET 1 OF 1				
P. O. BOX 7135 PROSPECT, CONN. 06712				HOLE NO. B-2								
CONTRACTOR: GBI #723				PROJECT NAME: Cleveland Brook Reservoir Dam				LINE				
FOREMAN-DRILLER: D.T. E.P.				LOCATION: Hinsdale, Massachusetts				STATION				
INSPECTOR: R.W.								OFFSET				
GROUND WATER OBSERVATIONS				CASING		SAMPLER		CORE BAR				
AT _____ FT. AFTER _____ HOURS				TYPE: HW		SS		NX				
AT _____ FT. AFTER _____ HOURS				SIZE: 1"		3"		2 1/8"				
				HAMMER WT. 300 LBS.		BIT 18" Carb. & Diam.		DATE: 9/10 9/10/76				
								SURFACE ELEV. _____				
								GROUND WATER ELEV. _____				
DEPTH	CASING BLWS PER FOOT	SAMPLE				BLOWS PER 6" ON SAMPLER FORCE ON TUBE			CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST.	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO	TYPE	PEN	REC.	0-6	6-12	12-18		MOIST	ELEV.	
5		1	SS	24"	18"	2	4	9	6	dry	5.5'	1) Topsoil & brown fine-medium sand, little fine gravel, trace silt.
		2	SS	24"	18"	3	5	7	6	medium		2) Light brown fine-medium sand, trace fine gravel, trace silt.
		3	SS	24"	18"	4	6	11	18	dry	5.0'	3) Gray-brown fine sand, little silt, little medium-fine gravel.
		4	SS	24"	18"	5	10	9	11	dense	8.5'	4) Same as sample #1, trace fractured rock.
10		5	SS	24"	18"	6	26	25	24	dry		5) Brown-gray fine-medium sand, trace silt, little fine-coarse gravel.
		6	SS	24"	18"	7	27	23	31	very dense	12.0'	6) Gray-brown coarse-fine sand, some fine gravel, trace silt.
		7	SS	24"	18"	8	31	39	46	very dense		7) Brown fine sand, trace fine gravel, trace silt.
15		8	SS	24"	18"	9	32	26	39			8) Brown-gray fine sand, trace silt, trace coarse sand, trace fine gravel.
		9	SS	24"	18"	10	31	14	11	moist		9) Same as sample #8, trace coarse gravel.
20		10	SS	24"	18"	11	16	17	18	medium		10) Same as sample #9.
		11	SS	24"	18"	12	19	23	19	moist		11) Same as sample #9.
		12	SS	24"	18"	13	61	46	32	dense		12) Brown-gray fine-medium sand, trace silt, little coarse-fine gravel.
25		13	SS	24"	18"	14	37	52	78	very dense		13) Same as sample #12.
		14	SS	24"	18"	15	52	27	22			14) Same as sample #12.
		15	SS	24"	18"	16	41	43	118			15) Same as sample #12.
30											30.0'	NOTE: Corer 15" boulder. Broke casing at 30.0' never boring 4.0' South.
35												END OF BORING 30.0' DEEP

TYPE OF SAMPLE: _____

DRURY _____ WASHED _____ UNWASHED _____

PROPORTIONS USED: TRACE <10% _____ 11-20% _____ 21-35% _____ 36-50% _____

TOTAL FOOTAGE

EARTH BORING _____ FT

ROCK CORING _____ FT

APPENDIX E-42

AD-A154 494

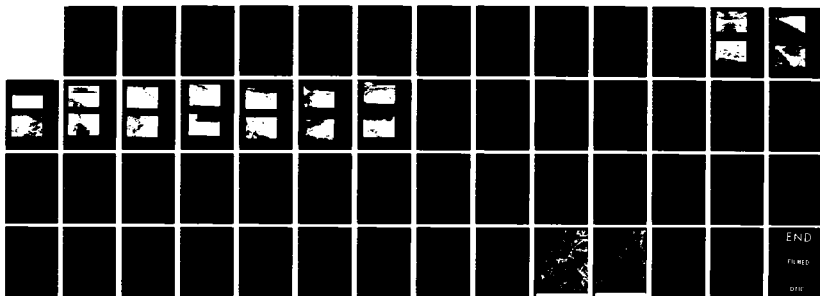
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
CLEVELAND BROOK RESER. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUN 79

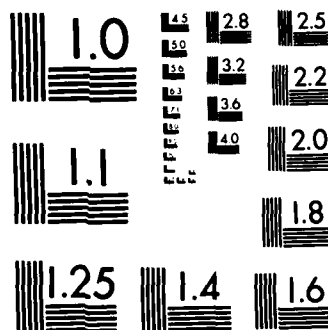
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

CLIENT: <u>Metcalf & Eddy, Inc.</u>				General Borings, Inc. P. O. BOX 7135 PROSPECT, CONN. 06712				SHEET <u>1</u> OF <u>1</u>	
CONTRACTOR GBI #723				PROJECT NAME Cleveland Brook Reservoir Dam				HOLE NO. <u>B-2-B</u>	
COREMAN-DRILLER D.T. E.P.				LOCATION Hinsdale, Massachusetts				LINE	
INSPECTOR J.B.								STATION	
GROUND WATER OBSERVATIONS AT <u>19</u> FT. AFTER _____ HOURS				TYPE BW				SAMPLER SS	
AT _____ FT. AFTER _____ HOURS				SIZE I.D. 2 1/2"				CORE BAR. 1 3/8"	
				HAMMER WT. 140				BIT 30"	
				OFFSET 3.0' South of B-2-A				DATE <u>9/16</u> <u>9/16, 71</u>	
								SURFACE ELEV. _____	
								GROUND WATER ELEV. _____	

DEPTH	CASING BLOWS PER FOOT	SAMPLE				DEPTH 3 BOT.	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE)			CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST.	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS ON WASH WATER, SEAMS IN ROCK, ETC.
		NO.	TYPE	PEN	REC.		0-6	6-12	12-18				
35'													Drilled with BW casing Drilled to 30.0', no sampler taken. Permeability Test at 30.0'. No recovery at 34.0'-40.0'. 1) Brown fine-medium sand, little silt, trace fine-medium gravel. 2) Same as sample #1, trace silt. 3) Same as sample #2. 4) Same as sample #1, little silt. 5) Same as sample #4. Refusal at 45.5' cored 1.0' boulder and cobbles to 46.0'. 6) Gray-brown fine-medium sand, little silt, little fine-medium gravel. 7) Same as sample #6, trace fractured rock. 8) Brown-gray fine-medium sand, trace silt, trace fine-medium gravel.
5		ss	24"	10"	36.0'	21	14	12	10	moist			
		1	ss	24"	16"	38.0'	11	10	11	moist			
10'		2	ss	24"	12"	40.0'	14	17	14	moist			
		3	ss	24"	9"	42.0'	11	16	21	dense			
		4	ss	24"	12"	44.0'	9	10	10	"			
15'		5	ss	18"	10"	45.5'	12	19	27	moist			
									50/0'	medium			
									very	dense			
20'		6	ss	24"	12"	50.0'	11	21	16	moist			
		7	ss	24"	14"	52.0'	16	22	27	dense			
25'		8	ss	24"	18"	54.0'	33	52	41	moist			
									very	dense			
30'													
35'													
40'													
45'													
50'													
55'													
60'													
65'													
70'													
75'													
80'													
85'													
90'													
95'													
100'													

TYPE OF SAMPLES: D=DRY W=WASHED C=CORED A=AUGER UP=UNDISTURBED PISTON UB=UNDISTURBED BALL CHECK VT=VANE TEST				TOTAL FOOTAGE	
PROPORTIONS USED TRACE=0-10% LITTLE=10-20% SOME=20-35% AND=35-60%				EARTH BORING _____ FT. ROCK CORING _____ FT.	

CLIENT: <u>Metcalf & Eddy, Inc.</u>		General Borings, Inc.		SHEET <u>1</u> OF <u>1</u>	
		P. O. BOX 7135 PROSPECT, CONN. 06712		HOLE NO. <u>B-3</u>	
CONTRACTOR <u>GRI #723</u>		PROJECT NAME <u>Cleveland Brook Reservoir Dam</u>		LINE	
FOREMAN-DRILLER <u>F.C. B.C.</u>		LOCATION <u>Hinsdale, Massachusetts</u>		STATION	
INSPECTOR <u>J.B.</u>				OFFSET	
GROUND WATER OBSERVATIONS		CASING SAMPLER CORE BAR.		DATE <u>9/8</u> <u>9/8/76</u>	
AT <u>9.5</u> FT. AFTER _____ HOURS		TYPE <u>HW</u> <u>SS</u>		SURFACE ELEV. _____	
AT _____ FT. AFTER _____ HOURS		SIZE I.D. <u>4"</u> <u>3"</u>		GROUND WATER ELEV. _____	
		HAMMER WT. <u>300</u> LBS. BIT <u>18"</u>			
		HAMMER FALL _____			

DEPTH	CASING BLOWS PER FOOT	SAMPLE				BLOWS PER 6" ON SAMPLER (FORCE ON TUBE)			CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO.	TYPE	PEN	REC.	DEPTH @ BOT.	0-6	6-12				
5		1	ss	24"	10"	2.0'	2	5	4	5		0.0'-19.0' cobbles and coarse gravel.
		2	ss	24"	12"	4.0'	8	10	15	21		1) Brown fine sand & coarse gravel, trace silt.
		3	ss	24"	10"	6.0'	21	29	47	54		2) Brown fine sand & medium gravel, trace silt.
		4	ss	24"	5"	8.0'	27	24	30	37		3) Brown fine-coarse sand, trace fine gravel, trace silt.
		5	ss	24"	12"	10.0'	10	16	17	14		4) Brown medium-coarse sand, trace silt and coarse gravel.
10		6	ss	24"	13"	12.0'	47	62	73	98		5) Brown fine-medium sand, trace silt & coarse gravel.
		7	C	24"		14.0'						6) Brown medium-fine sand, little silt, trace coarse-medium gravel.
15		8	ss	24"	15"	16.0'	19	16	37	29		7) Cored 12.0'-14.0', boulder 12.0'-13.0'.
		9	ss	24"	12"	18.0'	14	20	9	8		8) Brown fine-medium sand, little silt & coarse gravel.
20		10	ss	24"	18"	20.0'	1	4	20	24		9) Brown medium-coarse sand & medium-coarse gravel, trace silt.
		11	ss	24"	14"	22.0'	29	34	37	62		10) 1st 12"-layer wood fibers, trace peat and loose, brown fine sand, coarse gravel. Last 12" brown fine sand, little silt, trace medium-coarse gravel.
		12	ss	24"	16"	24.0'	19	18	18	17		11) Brown fine-medium sand & medium-coarse gravel.
25		13	ss	24"	10"	26.0'	18	17	17	16		12) Brown fine sand, trace silt, little medium-fine gravel.
		14	ss	24"	20"	28.0'	21	19	29	37		13) Brown fine sand, trace silt, trace fine-coarse gravel.
30		15	ss	24"	16"	30.0'	16	16	17	19		14) Brown fine sand.
												15) Brown fine sand, little silt, little medium-coarse gravel.
35												
40												

TYPE OF SAMPLES:				TOTAL FOOTAGE	
D=DRY	W=WASHED	C=CORED	A=AUGER	UP=UNDISTURBED PISTON	EARTH BORING _____ FT.
		UB=UNDISTURBED BALL CHECK	VT=VANE TEST		ROCK CORING _____ FT.
PROPORTIONS US: C TRACE=0-10% LITTLE=10-20% SOME=20-35%, AND=35-60%					

CLIENT: <u>Metcalf & Eddy, Inc.</u>				General Borings, Inc.				SHEET <u>1</u> OF <u>1</u>	
				P. O. BOX 7135 PROSPECT, CONN. 06712				HOLE NO. <u>B-4</u>	
CONTRACTOR GBI #723				PROJECT NAME Cleveland Brook Reservoir Dam				LINE	
FOREMAN-DRILLER F.C. B.C.				LOCATION Hinsdale, Massachusetts				STATION	
INSPECTOR J.B.								OFFSET	
GROUND WATER OBSERVATIONS AT <u>1</u> FT. AFTER <u>0</u> HOURS				TYPE CASING <u>HW</u> SAMPLER <u>SS</u> CORE BAR.				Start Finish DATE <u>9/13</u> <u>9/13/76</u>	
AT _____ FT. AFTER _____ HOURS				SIZE I.D. <u>4"</u>				SURFACE ELEV. _____	
				HAMMER WT. _____ 300 LBS. BIT				GROUND WATER ELEV. _____	
				HAMMER FALL <u>18"</u>					

DEPTH	CASING BLOWS PER FOOT	SAMPLE				BLOWS PER 6" ON SAMPLER (FORCE ON TUBE)	CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.	
		NO.	TYPE	PEN	REC.						DEPTH @ BOT.
		1	ss	24"	10"	2.0'	1	3	4		
		2	ss	24"	11"	4.0'	2	3	4	3	
5		3	ss	24"	9"	6.0'	3	3	4	3	
		4	ss	24"	11"	8.0'	3	3	3	40	
10		5	ss	24"	10"	10.0'	15	20	15	23	
		6	ss	24"	15"	12.0'	9	20	14	16	
		7	ss	24"	13"	14.0'	10	14	16	15	
15		8	ss	24"	14"	16.0'	9	10	9	11	
		9	ss	24"	24"	18.0'	7	9	14	20	
20		10	ss	24"	12"	20.0'	10	11	9	10	
		11	ss	24"	23"	22.0'	7	10	29	73	
25											
30											
35											
40											

TYPE OF SAMPLES: D=DRY W=WASHED C=CORED A=AUGER UP=UNDISTURBED PISTON UB=UNDISTURBED BALL CHECK VT=VANE TEST				TOTAL FOOTAGE	
PROPORTIONS USED TRACE=0-10% LITTLE=10-20% SOME=20-35% AND=35-60%				EARTH BORING _____ FT. ROCK CORING _____ FT.	

CLIENT: <u>Metcalf & Eddy, Inc.</u>		General Borings, Inc.		SHEET <u>1</u> OF <u>1</u>									
		P. O. BOX 7135 PROSPECT, CONN. 06712		HOLE NO. <u>B-5</u>									
CONTRACTOR <u>GBI #723</u>		PROJECT NAME <u>Cleveland Brook Reservoir Dam</u>		LINE									
JERMAN-DRILLER <u>D.T. E.P.</u>		LOCATION <u>Hindsdale, Massachusetts</u>		STATION									
INSPECTOR <u>J.B.</u>				OFFSET									
GROUND WATER OBSERVATIONS AT <u>18.25</u> FT. AFTER <u>0</u> HOURS		TYPE CASING <u>HW</u> SAMPLER <u>SS</u> CORE BAR. SIZE I.D. <u>4"</u> <u>3"</u> HAMMER WT. <u>300</u> LBS. BIT HAMMER FALL <u>18"</u>		DATE <u>9/20</u> <u>9/21/76</u> SURFACE ELEV. _____ GROUND WATER ELEV. _____									
DEPTH	CASING BLOWS PER FOOT	SAMPLE				BLOWS PER 8" ON SAMPLER (FORCE ON TUBE)			CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	STRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.	
		NO.	TYPE	PEN	REC.	DEPTH @ BOT.	0-8	8-12					12-18
5		1	ss	24"	9"	2.0'	9	17	16	17	dry	.5'	1) Topsoil & brown coarse-fine sand, little fine gravel.
		2	ss	24"	12"	4.0'	8	21	16	29	dense		2) Same as sample #1, no topsoil, trace coarse gravel.
		3	ss	24"	20"	6.0'	16	27	39	38	moist		3) Brown fine-medium sand, little silt, little fine-medium gravel.
		4	ss	24"	10"	8.0'	21	20	32	26	very dense		4) Same as sample #3.
10		5	ss	24"	12"	10.0'	28	36	32	26	"		5) Same as sample #3.
		6	ss	24"	10"	12.0'	20	30	35	55	"	12.83'	6) Same as sample #3, little fine gravel.
15		7	ss	4"	4"	2.83'	75/4"				"		7) Pressed tube 6"-recovered 6" 12.0'-12.5'.
			ss	0"	0"	14.0'	50/6"				"	16.0'	8) Same as sample #6, some fine-coarse gravel.
20		8	ss	24"	5"	18.0'	29	56	42	55	"		9) Cored cobbles & boulders 12.83'-14.0'. Refusal at 14.0' cored cobbles to 16.0'.
		9	ss	24"	7"	20.0'	27	39	26	35	"		10) Gray-brown fine-coarse sand, trace silt, trace fine gravel.
		10	ss	24"	6"	22.0'	29	56	54	61	"		11) Coarse-fine gravel (appears to be washed).
25		11	ss	24"	12"	24.0'	34	29	28	32	"		12) Gray-brown fine-coarse sand, some coarse-fine gravel, little silt.
			ss	24"	0"	26.0'	11	14	17	18	"		13) Gray-brown coarse-fine sand, some fine-medium gravel, trace silt.
		12	ss	24"	14"	28.0'	22	12	12	17	moist medium		No recovery 24.0'-26.0'.
30		13	ss	24"	3"	30.0'	21	17	20	16	moist dense		14) Same as sample #11, some coarse gravel.
		14	ss	24"	10"	32.0'	16	14	15	17	"		15) Coarse gravel in spoon tip.
		15	ss	24"	12"	34.0'	16	19	17	21	"		16) Gray-brown fine-medium sand, little silt, little fine-medium gravel.
35		16	ss	24"	14"	36.0'	15	15	16	19	"	36.0'	17) Same as sample #14.
											EOB		18) Same as sample #14.
												END OF BORING 36.0' Soil	
TYPE OF SAMPLES: D=DRY W=WASHED C=CORED A=AUGER UP=UNDISTURBED PISTON UB=UNDISTURBED BALL CHECK VT=VANE TEST PROPORTIONS USED TRACE=0-10% LITTLE=10-20% SOME=20-35% AND=35-60%												TOTAL FOOTAGE EARTH BORING _____ FT. ROCK CORING _____ FT.	

CLIENT: <u>Metcalf & Eddy, Inc.</u>				General Borings, Inc.				SHEET <u>1</u> OF <u>1</u>	
CONTRACTOR <u>GBI #723</u>				PROJECT NAME <u>Cleveland Brook Reservoir Dam</u>				HOLE NO. <u>B-6</u>	
DREMAN-DRILLER <u>F.C. B.C.</u>				LOCATION <u>Hinsdale, Massachusetts</u>				LINE	
INSPECTOR <u>J.B.</u>								STATION	
GROUND WATER OBSERVATIONS								OFFSET	
AT <u>17.5'</u> FT. AFTER _____ HOURS				TYPE				DATE <u>9/16</u> <u>9/16/76</u>	
AT _____ FT. AFTER _____ HOURS				CASING HW <u>4"</u> SAMPLER SS <u>3"</u> CORE BAR _____				SURFACE ELEV. _____	
				SIZE I.D. _____ HAMMER WT. _____ 300 LBS. BIT <u>18"</u>				GROUND WATER ELEV. _____	

DEPTH	CASING BLOWS PER FOOT	SAMPLE				BLOWS PER 6" ON SAMPLER (FORCE ON TUBE)			CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST. MOIST	SYRATA CHANGE DEPTH ELEV.	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO.	TYPE	PEN	REC.	DEPTH @ BOT.	0-6	6-12				
5		1	ss	24"	13"	2.0'	4	7	10	10		1) Brown fine sand, little silt, little medium-fine gravel.
		2	ss	24"	16"	4.0'	10	11	27	40		2) Brown fine sand, little silt and coarse gravel.
		3	ss	24"	13"	6.0'	23	21	24	30		3) Brown fine sand, little silt, trace medium-coarse gravel.
		4	ss	24"	14"	8.0'	19	28	32	41		4) Brown fine sand, little silt, trace fine-medium gravel.
10		5	ss	24"	13"	10.0'	23	39	47	62		5) Brown medium-coarse sand, little silt, trace medium-coarse gravel.
		6	ss	24"	5"	12.0'	37	49	67	74		6) Brown fine-medium sand, trace coarse gravel.
15		7	ss	24"	11"	14.0'	31	23	27	38		7) Brown fine-medium sand, trace fine-medium gravel.
		8	ss	24"	12"	16.0'	10	23	27	30		8) Brown medium-fine sand, little silt, trace fine-medium gravel.
20		9	ss	24"	13"	18.0'	19	18	27	26		9) Brown-gray fine-medium sand, little silt, trace medium-fine gravel.
		10	ss	24"	8"	22.0'	13	14	17	28		NOTE: Cored 18.0'-19.5', ran into boulder, ran casing to 20.0', recovered 1.5'.
25		11	ss	24"	10"	24.0'	16	17	23	26		10) Brown fine-medium sand, little silt, trace fine-medium gravel.
		12	ss	24"	17"	26.0'	26	34	39	41		11) Brown fine sand, little silt, trace medium-coarse gravel.
30		13	ss	24"	14"	28.0'	31	47	56	59		12) Brown fine sand, little silt, trace medium-fine gravel.
		14	ss	24"	11"	30.0'	37	51	63	79		13) Brown fine-medium sand, little silt, trace medium-coarse gravel.
35												14) Brown-gray fine-medium sand, little silt, trace medium-coarse gravel.
40												END OF BORING 30.0' + 1.1'

TYPE OF SAMPLES: D=DRY W=WASHED C=CORED A=AUGER LP=UNDISTURBED PISTON UB=UNDISTURBED BALL CHECK VT=VANE TEST				TOTAL FOOTAGE	
PROPORTIONS USED TRACE=0-10% LITTLE=10-20% SOME=20-35% AND=35-50%				EARTH BORING _____ FT. ROCK CORING _____ FT.	

CLIENT: <u>Metcalf & Eddy, Inc.</u>				General Borings, Inc.				SHEET <u>1</u> OF <u>1</u>	
P. O. BOX 7135 PROSPECT, CONN. 06712								HOLE NO. <u>B-7</u>	
CONTRACTOR <u>GBI #723</u>				PROJECT NAME <u>Cleveland Brook Reservoir Dam</u>				LINE	
JUREMAN-DRILLER <u>F.C. B.C.</u>				LOCATION <u>Hinsdale, Massachusetts</u>				STATION	
INSPECTOR <u>J.B.</u>								OFFSET	
GROUND WATER OBSERVATIONS				CASING SAMPLER CORE BAR.				Start Finish	
AT <u>6.25</u> FT. AFTER <u>0</u> HOURS				TYPE <u>HW</u> <u>SS</u>				DATE <u>9/15</u> <u>9/15/76</u>	
AT _____ FT. AFTER _____ HOURS				SIZE I.D. <u>4"</u> <u>3"</u>				SURFACE ELEV. _____	
				HAMMER WT. <u>300</u> LBS. BIT <u>18"</u>				GROUND WATER ELEV. _____	
				HAMMER FALL _____					

DEPTH	CASING BLOWS PER FOOT	SAMPLE				BLOWS PER 6" ON SAMPLER (FORCE ON TUBE)			CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST.	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.	
		NO.	TYPE	PEN	REC.	0-6	6-12	12-18					
5		1	ss	24"	14"	2.0'	3	2	3	2		4.5'	1) Brown fine sand, little silt, little fine gravel and tree roots.
		2	ss	24"	11"	4.0'	3	2	3	9			2) Brown fine sand, little silt, trace fine gravel.
		3	ss	24"	15"	6.0'	9	17	17	31			3) Brown fine sand, little silt, trace fine-coarse gravel, tree roots mixed.
		4	ss	24"	13"	8.0'	28	27	31	35			4) Brown medium-coarse sand, trace fine-medium gravel.
10		5	ss	24"	16"	10.0'	10	17	16	11		5) Brown fine sand, little silt, trace fine-medium gravel.	
		6	ss	24"	13"	12.0'	10	13	12	14		6) Brown fine sand, little silt, trace fine-coarse gravel.	
		7	ss	24"	14"	14.0'	13	14	13	14		7) Brown fine sand, little silt, little fine-coarse gravel.	
15		8	ss	24"	16"	16.0'	11	10	13	20		8) Brown fine sand, little silt, little medium-coarse gravel.	
		9	ss	24"	16"	18.0'	11	15	10	14		9) Brown fine-medium sand, little silt, trace medium-coarse gravel.	
		10	ss	24"	14"	20.0'	9	12	15	17		10) Brown fine-medium sand, little silt, little fine-coarse gravel.	
20		11	ss	24"	16"	22.0'	15	27	34	41		11) Gray-brown fine-medium sand, little silt, trace fine-coarse gravel.	
		12	ss	24"	11"	24.0'	27	34	49	61		12) Gray-brown medium-coarse sand, trace fine-medium gravel, little silt.	
		13	ss	12"	6"	25.0'	27	31				13) Gray-brown medium-coarse sand, trace medium-coarse gravel.	
25												END OF BORING 25.0' ± 1	
												Installed one Piezometer at 18.0'	
30													
35													

TYPE OF SAMPLES				TOTAL FOOTAGE				
D-DRY	W-WASHED	C-CORED	A-AUGER	UP-UNDISTURBED PISTON	EARTH BORING _____ FT.			
UB-UNDISTURBED BALL CHECK				VT-VANE TEST	ROCK CORING _____ FT.			
PROPORTIONS USED								
TRACE < 0-10% LITTLE < 10-20% SOME < 20-35% AND < 35-60%								

CLIENT: <u>Metcalf & Eddy, Inc.</u>				General Borings, Inc.				SHEET <u>1</u> OF <u>1</u>	
P. O. BOX 7135 PROSPECT, CONN. 06712				PROJECT NAME <u>Cleveland Brook Reservoir Dam</u>				HOLE NO. <u>B-8</u>	
CONTRACTOR <u>GBI #723</u>				LOCATION <u>Hinsdale, Massachusetts</u>				LINE	
BUREAU-DRILLER <u>D.T. E.P.</u>				INSPECTION				OFFSET	
INSPECTOR <u>J.B.</u>				GROUND WATER OBSERVATIONS				DATE <u>9/16</u> <u>9/20/76</u>	
AT <u>14</u> FT. AFTER <u>24</u> HOURS				TYPE <u>HW</u> <u>SS</u>				SURFACE ELEV. _____	
AT _____ FT. AFTER _____ HOURS				SIZE I.D. <u>4"</u> <u>3"</u>				GROUND WATER ELEV. _____	
HAMMER WT. _____				CORE BAR.					
HAMMER FALL <u>18"</u>				BIT					

DEPTH	CASING BLOWS PER FOOT	SAMPLE				DEPTH @ BOT.	BLOWS PER 6" ON SAMPLER (FORCE ON TUBE)			CORING TIME PER FT. (MIN.)	DENSITY OR CONSIST.	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL REMARKS INCL. COLOR, LOSS OF WASH WATER, SEAMS IN ROCK, ETC.
		NO.	TYPE	PEN	REC.		0-6	6-12	12-18				
5		1	ss	24"	19"	2.0'	9	11	10	13	dry		1) Topsoil and light brown fine medium sand, trace silt, trace fine gravel.
		2	ss	24"	20"	4.0'	13	15	21	32	dry		2) Same as sample #1, trace medium gravel.
		3	ss	24"	20"	6.0'	16	29	56	39	very dense		3) Gray-brown fine-medium sand, trace silt, trace fine-medium gravel, trace coarse gravel.
		4	ss	24"	18"	8.0'	14	30	33	45	"		4) Same as sample #3, no coarse gravel.
10		5	ss	24"	14"	10.0'	19	24	32	53	"		5) Same as sample #4.
		6	ss	12"	8"	11.0'	36	100			moist		6) Brown-gray fine-medium sand, trace coarse sand, trace silt, some fine-coarse gravel.
15		7	ss	24"	16"	15.0'	29	46	52	35	very dense		NOTE: Refusal at 11.0', cored cobbles to 13.0'
		8	ss	24"	18"	17.0'	27	36	39	40	"		7) Brown fine-medium sand, trace silt, some fine-medium gravel.
20		9	ss	24"	19"	19.0'	19	20	16	12	moist		8) Brown-gray fine sand, some silt, some fine-medium gravel.
		10	ss	24"	9"	21.0'	12	11	11	10	medium		9) Brown fine-medium sand, trace silt, little fine-medium gravel.
		11	ss	24"	6"	23.0'	6	8	5	5	"		10) Brown fine-medium sand, little silt, little fine gravel, trace fractured rock.
25			ss	24"	0"	25.0'	8	8	7	8			11) Brown fine-medium sand, little silt, little fine-medium gravel.
		12	ss	24"	3"	27.0'	14	11	10	9	wet		Note: No recovery at 25.0'.
30		13	ss	24"	9"	29.0'	7	8	7	9	medium		12) Brown fine-medium sand, little fine-medium gravel, trace silt.
		14	ss	24"	3"	31.0'	8	29	21	19	wet		13) Same as sample #12.
		15	ss	24"	16"	33.0'	12	16	15	17	dense		14) Same as sample #12.
35													15) Same as sample #12.
		16	ss	24"	12"	35.0'	19	20	56	33	wet	35.0'	16) Same as sample #12, some coarse gravel.
										very dense	EOB		END OF BORING 35.0' Soil

TYPE OF SAMPLES				TOTAL FOOTAGE	
D=DRY	W=WASHED	C=CORED	A=AUGER	UP=UNDISTURBED PISTON	EARTH BORING _____ FT
		UB=UNDISTURBED BALL CHECK	VT=VANE TEST		ROCK CORING _____ FT
PROPORTIONS USED					
TRACE=0-10%		LITTLE=10-20%	SOME=20-35%, AND=35-50%		

APPENDIX C

SELECTED PHOTOGRAPHS OF PROJECT

LOCATION PLAN

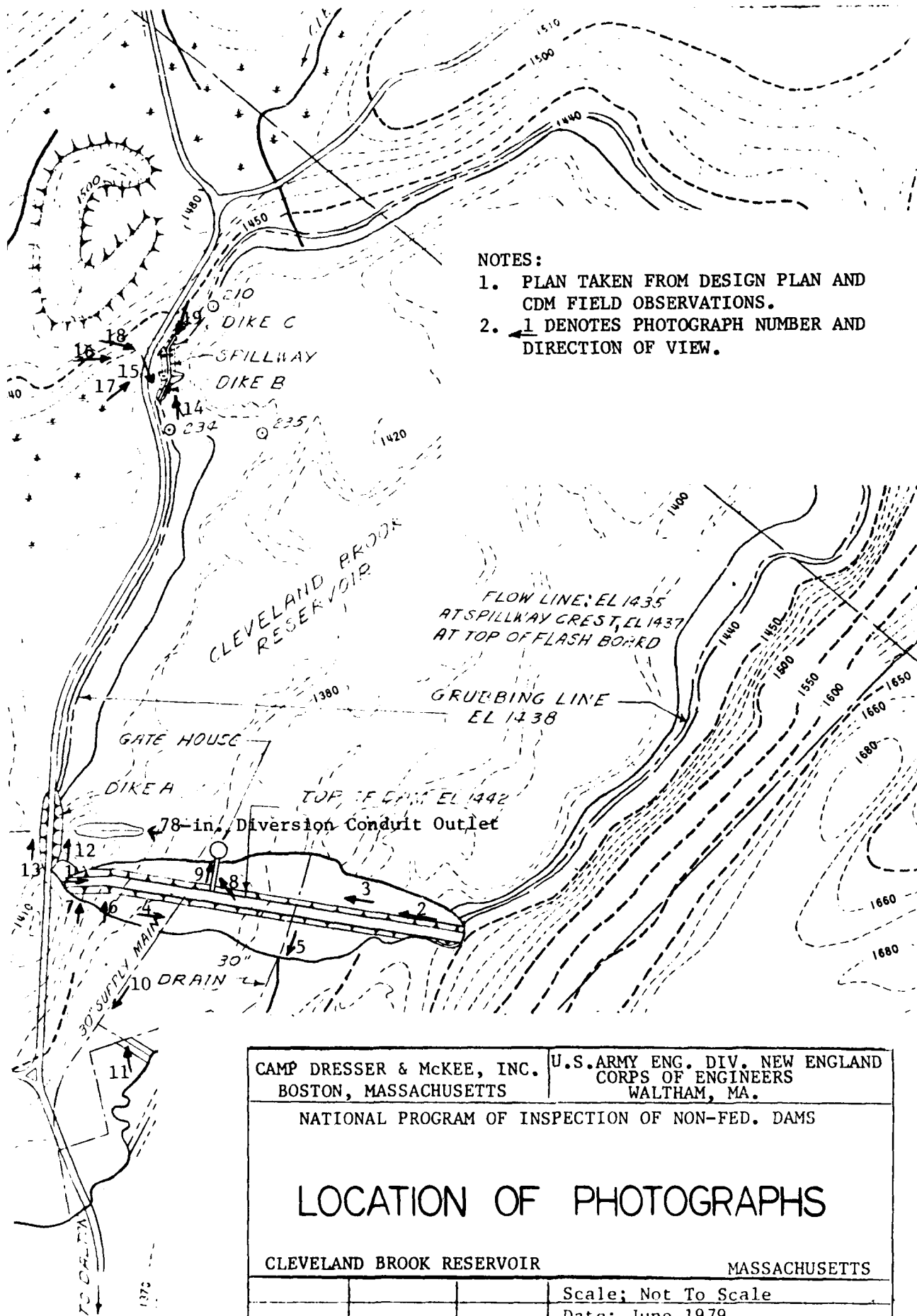
Page No.

Location of Photographs

C-1

PHOTOGRAPHS

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1.	Overview of Dam From Right Abutment	iv
2.	Crest of Dam From Left of Dam	C-2
3.	Riprap at Upstream Face of Dam	C-2
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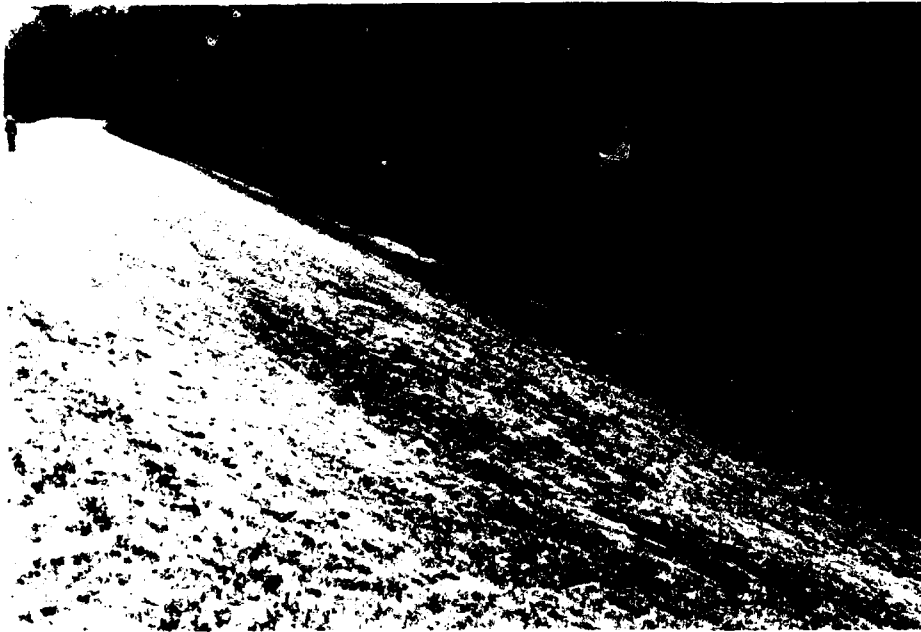




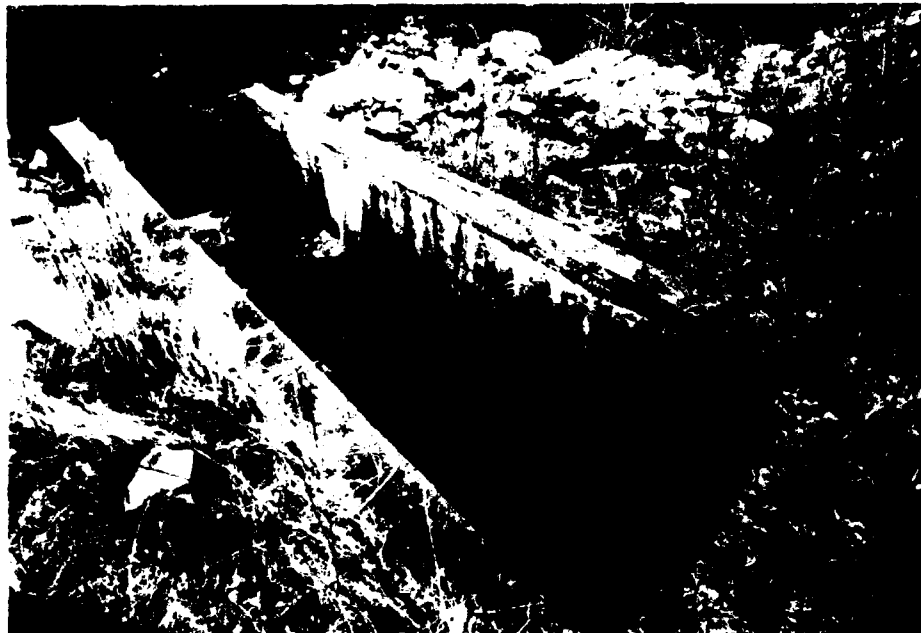
2. CREST OF DAM FROM LEFT OF DAM.



3. RIPRAP AT UPSTREAM FACE OF DAM.



4. DOWNSTREAM FACE OF DAM VIEWED FROM RIGHT SIDE.



5. RESERVOIR DRAIN AND DRAINAGE PIPE OUTLET AT TOE OF DAM.

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 DETAIL Cleveland Port Rev.
JOB NO 380-6-RT-10PAGE 5DATE CHECKED 7/20/79DATE 7-18-79CHECKED BY JEDCOMPUTED BY Lee H.Stage - Discharge Relationship

Upstream W.S. El.	Spillway Qs	Right Embankment				Left Embankment				Main Dam	Dke A	Total
		Qr1	Qr2	Qr3	Qr4	Ql1	Ql2	Ql3	Ql4			
1437	—	—	—	—	—	—	—	—	—	—	—	ZERO
1438	266	—	—	—	—	—	—	—	—	—	—	266
1439	750	—	—	—	—	—	—	—	—	—	—	750
1440	1375	—	—	—	—	—	375	—	—	—	—	1750
1441	2110	—	—	—	—	—	1028	—	—	—	—	3138
1442	2941	294	10	—	10	126	1911	112	10	—	—	5404

CLIENT COE

ADJ NO 380-6-RF-10

PAGE 4

PROJECT Dam Insp.

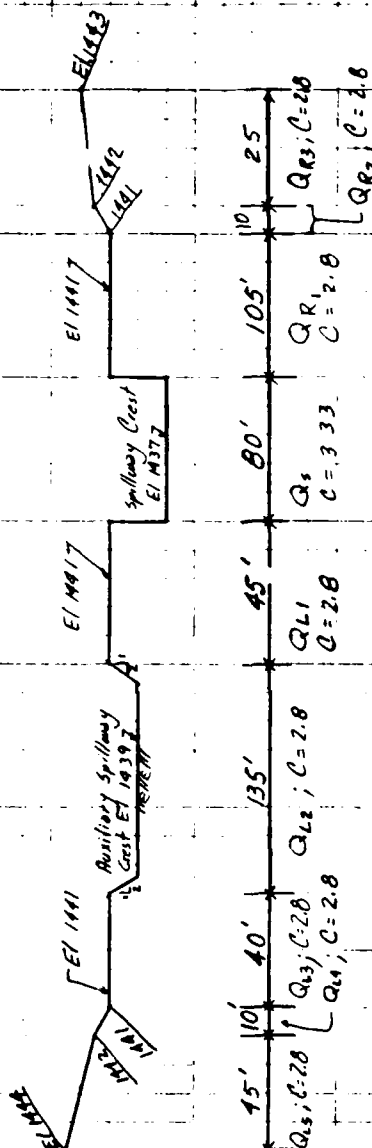
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DETAIL Cleveland Brook Reservoir

CHECKED BY JED

COMPUTED BY Jac. R.



CLIENT COE
 PROJECT DAM INSP.
 DETAIL Cleveland Pond Reservoir
JOB NO 380-6-RF-10DATE CHECKED 7/20/79CHECKED BY JEDPAGE 3DATE 7-18-79COMPUTED BY Joe R.TEST FLOOD DETERMINATION

The dam is classified as ^{being of} intermediate size and high hazard.

Test Flood is PMF

The terrain in the drainage area is rolling with a small area which is flat. Base the PMF determination on a point on the curve labelled "Rolling" terrain. The curve is taken from the N. E. D. Corps of Engineer's "Preliminary Guidance for Estimating PMF in Phase I Dam Safety Investigations", March, 1978.

$$\text{PMF} = 2200 \text{ cfs} / \text{mi.}^2 \times 1.52 \text{ mi.}^2 = 3,344 \text{ cfs}$$

say 3,350 cfs

STAGE-DISCHARGE RELATIONSHIPS

Assume conditions as they were during field investigation

i.e. flashboards in-place; spillway crest el 1437.0

Compute Stage-Discharge Relationship (see weir profile next page)

Flow over the spillway is:

$$Q (\text{cfs}) = 3.33 (B - 0.1 n H) H^{3/2}$$

Flow Over the Embankments, Main Dam and Dike A is:

$$Q (\text{cfs}) = 2.8 B H^{3/2}$$

where B = Length of weir, ft

H = Upstream Head measured above the crest. Use avg. Head where the weir is sloped

n = number of contraction

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ELEVATIONS

Spillway crest w/ and w/o flashboards	1437.0 ; 1435.0
Top of Main Dam	1371.0
Crest of Main Dam & DiKE P	1442.0
Right Spillway Embankment (DiKE C)	1441.0
Left Spillway Embankment (DiKE B)	1439.0

Elevations based on 1963 Construction Alteration Dwg.
 Datum is the 1927 National Vertical Geodetic Datum.

SURFACE AREAS

@ cl 1429.0 ; 144.6 acres \approx 0.226 mi. sq. (Pond Surface Area)
 1440.0 ; 156.6 acres \approx 0.245 mi. sq. "
 1450.0 ; 183.2 acres \approx 0.286 mi. sq. "

Drainage area = 972.8 acres = 1.52 mi. sq.

STORAGE VOLUMES

From 1963 Melchiff & Eddy report (latest alterations), reservoir storage with two feet of flashboards in-place (El. 1437.0) is 5,230 acre-feet. At elevation 1435.0, storage is 4,928 ac-ft.

@ cl 1440.0 = $5,230 \text{ ac-ft} + (150.6 \text{ ac}) 3 \text{ ft} = 5,682 \text{ ac-ft}$

@ cl 1445.0 = $5,682 + \left(\frac{183.2 + 156.6}{2} \right) 5 = 6,532 \text{ ac-ft}$

SIZE CLASSIFICATION

Hydraulic Height = 70 feet intermediate
 The hydraulic height is based on a W.S. El. of 1441 at dam failure.

Storage at Top of Dam (El. 1442) = 6,022 ac-ft intermediate

HAZARD CLASSIFICATION

The dam failure analysis (pages 9 - 28) indicates severe damage to property and a high potential for loss of life.

Hazard is HIGH

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT COE
PROJECT Perm Insp.
DETAIL CLEVELAND BROOK

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RESERVOIR

Scale of Mapping $1" = 2000'$ $14.83 \times 96.83 = 1436 \text{ Acres (A)}$
 $* A = 640 \cdot \text{mi}^2$

DRAINAGE AREA

1. 8.02 \rangle 8.01 $\text{ave} = 8.01 \text{ mi}^2 = 736 \text{ A} = 1.150 \text{ mi}^2$ ✓
2. 8.00 \rangle plus 0.37 sq. mile area east of Schnepps Road diverted to the reservoir by a culvert as stated in original design computations of 1948 by M&E

WATER SURFACES

EL. 1429

1. 1.56 \rangle 1.575 $\text{ave} = 1.575 \text{ mi}^2 = 144.6 \text{ A} = 0.226 \text{ mi}^2$ ✓
2. 1.59 \rangle

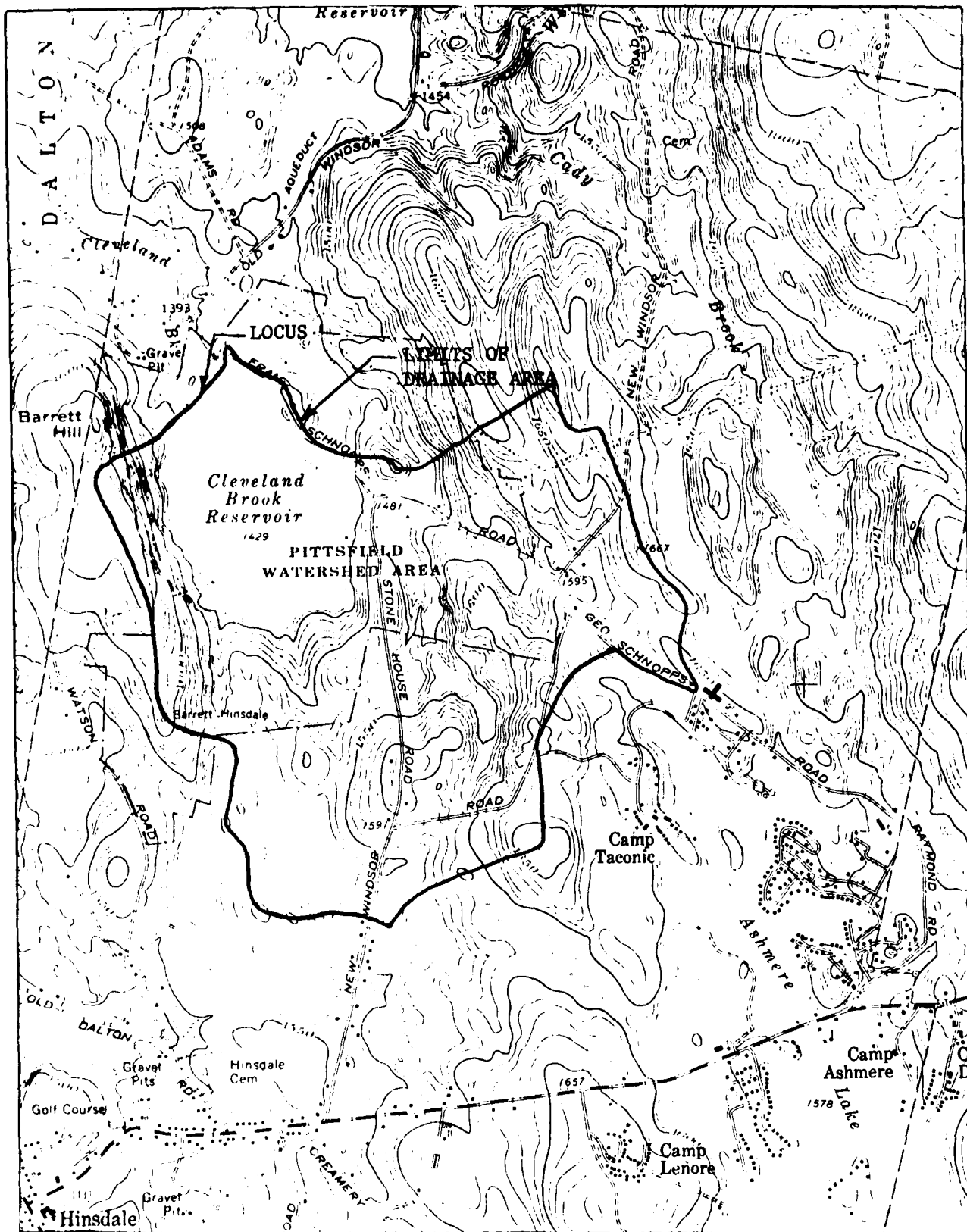
EL 1440

1. 1.70 \rangle 1.705 $\text{ave} = 1.705 \text{ mi}^2 = 156.6 \text{ A} = 0.245 \text{ mi}^2$ ✓
2. 1.71 \rangle

EL 1450

1. 1.99 \rangle 1.995 $\text{in}^2 = 183.2 \text{ Acres} = 0.286 \text{ mi}^2$
2. 2.00 \rangle

Elevations Based on National Vertical Geodetic Datum



DAM CLEVELAND BROOK RESERVOIR

IDENTIFICATION NO. MA 00225



DRAINAGE AREA MAP
USGS QUADRANGLE

PERU, MASS

APPROX. SCALE: 1" = 2000'

APPENDIX D-1

APPENDIX D

MAPS AND HYDRAULIC/HYDROLOGIC COMPUTATIONS

	<u>Page No.</u>
<u>DRAINAGE AREA MAP</u>	D-1
<u>COMPUTATIONS</u>	
Drainage Area; Water Surface Areas	D-2
Elevations; Surface Areas; Storage Volumes;	
Size Classification; Hazard Classification	D-3
Test Flood Determination; Stage-Discharge Relationships	D-4
Surcharge Storage Routing	D-8
Tailwater Analysis	D-9
Dam Failure Analysis	D-10
Dam Failure Impact Area Map	D-30



18. VIEW TOWARDS SPILLWAY FROM DOWNSTREAM. LOW FLOW PIPE BENEATH ROAD OUTLETS IN FOREGROUND. DIKE C AT LEFT SIDE OF PICTURE AND DIKE B ON RIGHT SIDE OF PICTURE.



19. OVERVIEW OF DIKE C FROM EAST END. SPILLWAY AND DIKE B IN BACKGROUND.



16. SPILLWAY WEIR FROM DOWNSTREAM OF DIKE B.



17. SEEPAGE DOWNSTREAM OF SPILLWAY DISCHARGE APRON. DROP INLET FOR LOW FLOW PIPE BENEATH ROADWAY IN UPPER LEFT CORNER OF THE PICTURE.



14. OVERVIEW OF DIKE B AND OVERFLOW SPILLWAY FROM WEST END.



15. RIPRAP PROTECTION OF OVERFLOW SPILLWAY INVERT.



12. UPSTREAM FACE OF DIKE A FROM DAM RIGHT ABUTMENT.



13. CREST AND DOWNSTREAM FACE OF DIKE A FROM WEST END.



10. VALVE CHAMBER ON WATER TRANSMISSION MAIN DOWNSTREAM OF DAM.



11. HEADWALL FOR BLOW-OFF FROM TRANSMISSION MAIN VALVE CHAMBER.



8. INTAKE GATEHOUSE (CONTROL TOWER) FOR WATER TRANSMISSION MAIN.



9. INTERIOR OF GATEHOUSE.



6. OBSERVATION WELLS ON DOWNSTREAM FACE OF DAM NEAR RIGHT ABUTMENT.



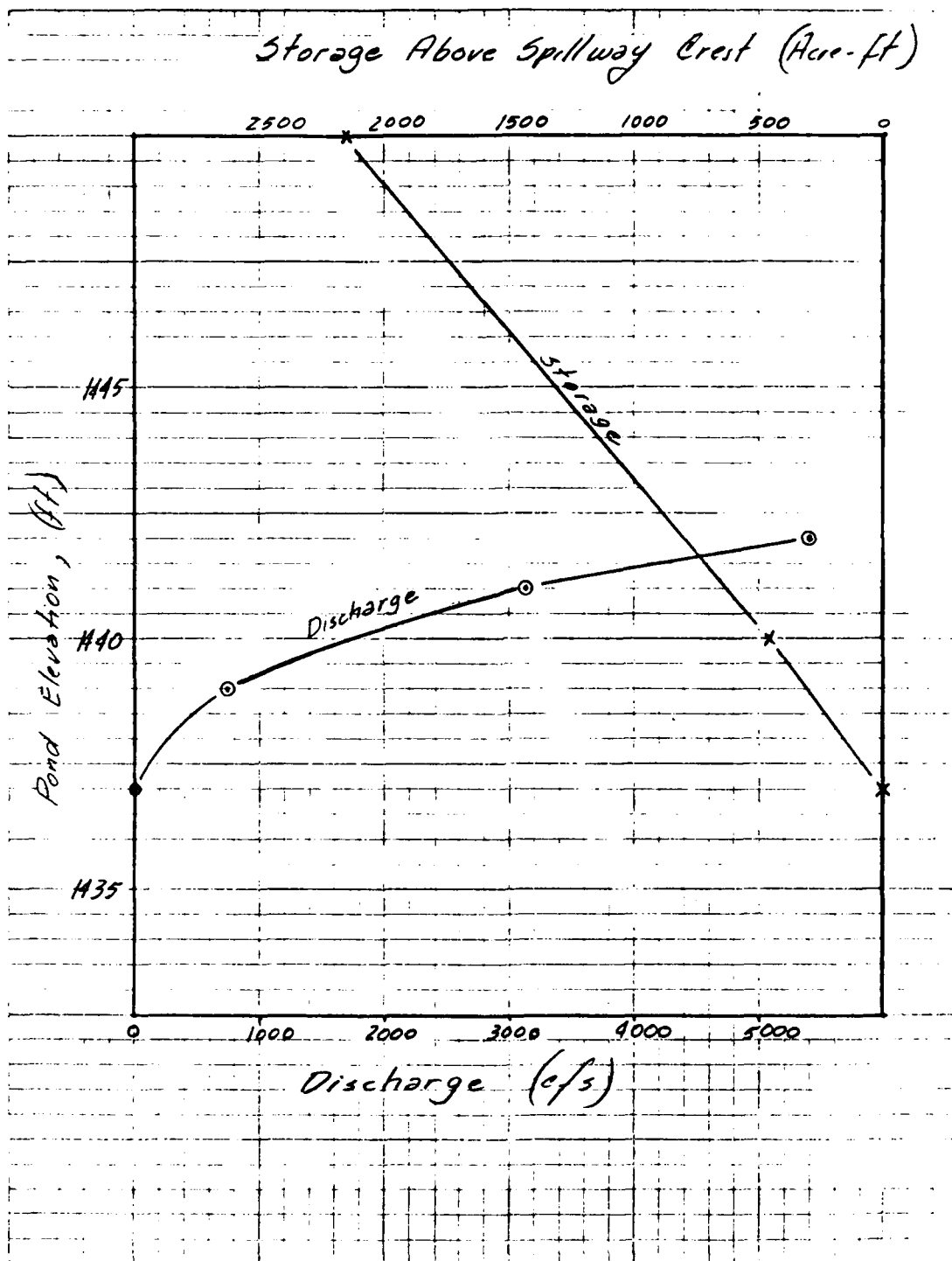
7. SEEPAGE AND FLOW MEASURING PIPE ON DOWNSTREAM FACE OF DAM NEAR RIGHT ABUTMENT.

CAMP DRESSER & MOORE INC.

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SURCHARGE STORAGE ROUTING

 $Q_p = 3,350 \text{ cfs}$ (see page 3 ; TEST FLOOD)

 Surcharge Height to Pass Q_p is 1441.1 ft

$$STOR_1 = \frac{\text{Surcharge Storage}}{\text{Drainage Area}} = \frac{639 \text{ Ac-ft} \times 12 \text{ ft}}{973 \text{ Ac}} = 7.881''$$

Probable Max. Flood Runoff:

$$Q_{p_2} = Q_p \times \left(1 - \frac{STOR_1}{19}\right) = 3,350 \times \left(1 - \frac{7.881}{19}\right) = 1,960 \text{ cfs}$$

 Surcharge Height to Pass Q_{p_2} is 1440.15

$$STOR_2 = \frac{478 \times 12}{973} = 5.895''$$

$$STOR_{AVG} = \frac{7.881 + 5.895}{2} = 6.888 \text{ inches}$$

$$Q_{p_3} = Q_p \times \left(1 - \frac{STOR_{AVG}}{19}\right) = 3,350 \times \left(1 - \frac{6.888}{19}\right) = 2,136 \text{ cfs}$$

 Surcharge Height To Pass Q_{p_3} is 1440.28 ft

$$\text{Related } STOR = \frac{500 \times 12}{973} = 6.170 \text{ in} < STOR_{AVG}$$

$= STOR_3$

 then compute Q_{p_4}

$$\text{New } STOR_{AVG} = \frac{6.888 + 6.170}{2} = 6.529 \text{ inches}$$

$$Q_{p_4} = 3,350 \times \left(1 - \frac{6.529}{19}\right) = 2,199 \text{ cfs, say } 2,200 \text{ cfs}$$

 Surcharge Height To Pass Q_{p_4} is 1440.35 ft

Flow through spillway at test flood elevation (1440.35')

$$Q_s = 3.33(80)(3.35)^{1.5} = 1,633 \text{ cfs, say } 1,630 \text{ cfs}$$

Flow through Emergency spillway @ el 1440.35'

$$Q_{L_2} = 2.8(5.1)(0.675)^{1.5} + 2.8(127)(1.35)^{1.5} = 566 \text{ cfs}$$

say 570 cfs

TAILWATER ANALYSIS:

determine the capacity of the natural channel immediately
D/S of the main spillway @ D/S WSEL = spillway crest El.:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where $n \approx 0.095$

$$A = 100 \times 7 = 700 \text{ sq ft}$$

$$R = \frac{A}{P} = \frac{700}{110} = 6.36$$

$$\therefore Q = \frac{1.49}{0.095} 700 (6.36)^{0.667} (0.015)^{1/2} S \approx 0.015$$

= 9,750 cfs >>> 1,633 cfs which discharges
through the main spillway as a
result of the Test Flood.

determine the capacity of the natural channel
immediately downstream of the auxiliary spillway
@ D/S WSEL = spillway crest El.:

$$\text{again } Q = \frac{1.49}{n} R^{2/3} S^{1/2}$$

where $n \approx 0.05$

$$A = 180 \times 1 = 180$$

$$R = \frac{180}{180} = 1$$

$$S \approx 0.015$$

$$\therefore Q = \frac{1.49}{0.05} 180 (1)^{0.667} (0.015)^{1/2}$$

= 660 cfs > 566 cfs discharging at Test Flood

In addition to the capacity of the channel immediately
D/S of the auxiliary spillway, discharge from the
auxiliary spillway can freely flow to the channel
immediately D/S of the main spillway thus
eliminating the possibility of tailwater effects.

DAM FAILURE ANALYSIS

determine Q_p .

$$Q_p = 8/27 (W_b)(g)^{1/2} (Y_o)^{3/2}$$

where: W_b = 40% of the dam width measured at the mid-height of the dam
= $1085 \times 0.4 = 434$ ft.

$$g = 32.2 \text{ ft/sec}^2$$

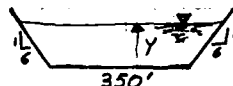
Y_o = Hydraulic height at time of dam failure. Assume pond level at top of spillway dam.
= $1411 - 1371$
= 70 ft

$$Q_p = 8/27 (434)(32.2)^{1/2} (70)^{3/2}$$

$$= 427,350 \text{ cfs}$$

REACH I: Dam to first crossing of Windsor Rd. and Cleveland Brook. Cleveland Brook crosses Old Windsor Rd. through a 6' ϕ steel culvert. A V-notch weir is welded onto the d/s side of the 6' ϕ steel culvert.

Assume a trapezoidal X-section and compute depth of flow.



$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

where n = Manning's coeff assumed @ 0.085

A = area, ft^2

R = A/P , ft (hydraulic radius)

S = P slope, $\text{ft/ft} = 0.015$

Y = depth of flow, ft

Y ft	Area ft^2	Q cfs
25	12,500	362,300
30	15,900	509,900

Reach 1 (cont.)

depth of flow to carry 427,350 cfs is 27.2 ft.

compute storage in reach 1 and route flow:

$$V_1 = \left[12,500 + \frac{(5,900 - 12,500) 2.7}{10} \right] \times 1280 \text{ ft} \times \frac{1 \text{ A.C.}}{43560 \text{ ft}^2}$$

$$= 395 \text{ ac-ft}$$

$$\text{then, } Q_{P_2}(\text{trial}) = Q_{P_1} \left(1 - \frac{V_1}{S} \right)$$

$$= 427,350 \left(1 - \frac{395}{2954} \right)$$

$$= 370,200 \text{ cfs}$$

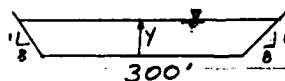
$Q_{P_1} = 427,350 \text{ cfs}$
 $V_1 = 395 \text{ ac-ft}$
 $S = \text{storage @ time of dam failure} = 2954 \text{ ac-ft}$
based on a prismatical app.

based on Q_{P_1} trial $V_2 = 350 \text{ ac-ft}$: $V_{\text{avg}} = 373 \text{ ac-ft}$.

$$Q_{P_2} = 427,350 \left(1 - \frac{373}{2954} \right) = 373,400 \text{ cfs} : Y = 25.4'$$

REACH 2: First to second crossing of Old Windsor Rd and Cleveland Brook. The brook culvert is a 6'Ø corrugated metal pipe, which is of little significance relative to the magnitude of the dam failure outflow.

Assume a trapezoidal X-section and determine depth of flow:



Slope for reach = 0.025
 $n = 0.045$

$$Q = \frac{1.49}{0.045} \left[(300 + 8Y) Y \right] \left(\frac{(300 + 8Y) Y}{300 + 2Y \sqrt{65}} \right)^{0.6667} (0.025)^{0.5}$$

Y ft	Area ft ²	Q cfs
15	6300	169,250
20	9200	290,100
25	12,500	445,750

average width for storage determination

$$Y_1 = 22.7' ; V_1 = \frac{800' \times 22.5' \times 1300'}{13560} = 537 \text{ ac-ft}$$

Reach 2 (cont.)

$$Q_{p_2}(\text{trial}) = 373,400 \left(1 - \frac{537}{2954}\right) = 305,450 \text{ cfs}$$

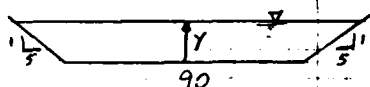
based on $Q_{p_2}(\text{trial})$, $V_2 = \frac{20.5 \text{ ft deep } 537 \text{ ac-ft}}{22.5 \text{ ft deep}} = 489 \text{ ac-ft.}$

$$V_{\text{avg}} = 513 \text{ ac-ft.}$$

$$Q_{p_2} = 373,400 \left(1 - \frac{513}{2954}\right) = 308,550 \text{ cfs}$$

$$Y = 20.6'$$

REACH 3: Second to third crossing of Old Windsor Road and Cleveland Brook. The brook crosses under the road through bridge opening 11 ft by 11 ft. The bridge is of small hydraulic significance when dealing with a flow of about 300,000 cfs. Determine depth of flow in the reach based on a trapezoidal X-section.



Slope for reach = 0.05
 $n = 0.045$

$$Q = \frac{1.49}{0.045} (90 + 5Y) Y \left(\frac{(90 + 5Y) Y}{90 + 2Y \sqrt{26}} \right)^{0.667} (0.05)^{0.5}$$

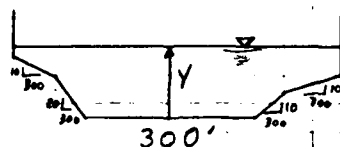
Y ft	A ft ²	Q cfs
25	5,375	298,250
30	7,200	368,650

@ $Q = 308,550 \text{ cfs}$ $Y = 27.5 \text{ ft.}$

Given the steep slope, storage for the reach is negligible.

Assume $Q_{\text{out}} = 305,000 \text{ cfs}$

REACH 9: Third crossing of Cleveland Brook and Old Windsor Road to confluence of Cleveland Brook and the East Branch of the Housatonic River. A section of this reach just downstream of the Old Windsor Rd can be assumed to have similar characteristics as reach 3. Assume depth of water in this reach to be about 27.5 ft. Beyond this section, the topography changes radically. The slope flattens out and the overbank storage becomes very significant. Assume the following X-section to calculate depth of flow.



$$\text{Slope} = 0.01$$

$$n = 0.095$$

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Y ft	A ft ²	P ft	Q cfs
20	17,000	1,600	272,100
25	29,250	1,755	462,350

Storage

Y, ft	El. @ pt. of Confluence	Area, ac-ft	Storage, ac-ft
10	1150	8.3	$8.3 \times 5 = 42$
20	1160	35	$42 + 21.7 \times 10 = 259$
30	1170	78	$259 + 56.5 \times 10 = 824$

depth of water to pass 305,000 cfs is 20.9 ft.

$$V_1 = 310 \text{ ac-ft. } Q_{p_2}(\text{trial}) = 305,000 \left(1 - \frac{310}{2959}\right) = 273,000 \text{ cfs}$$

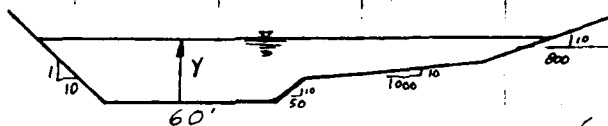
based on $Q_{p_2}(\text{trial})$, $V_2 = 260 \text{ ac-ft. } ; V_{avg} = 267 \text{ ac-ft.}$

$$Q_{p_2} = 305,000 \left(1 - \frac{267}{2959}\right) = 277,450 \text{ cfs}$$

$$Y = 20.2 \text{ ft}$$

WSEI @ confluence of Cleveland Bk and the
East Branch of the Housatonic River ≈ 1160.2

REACH 5 Confluence of Cleveland Brook and the East Branch of the Housatonic River to street just upstream of Center Pond. The importance of the bridge relative to the flow is minor. Assume the road to blend into the surrounding topo, and bare the depth of water on a C trapezoidal X-section.



slope ≈ 0.0036
 $n \approx 0.095$ } assumed $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

Y, ft	Area, ft ²	Perimeter, ft	Q, cfs
25	17,625	1,760	162,700
30	26,550	2,210	276,700
20	8,950	1,310	64,000

Storage

Y, ft	WSE @ Bridge, ft	Area (acres)	Storage, ac-ft
10	1150	27	$27 \times 6.5 = 176$
20	1160	48	$176 + 37.5 \times 10 = 551$
30	1170	128	$551 + 88 \times 10 = 1431$
40	1180	222	$1431 + 175 \times 10 = 3181$

WSE to pass 277,450 cfs is 1170

$V_1 = 1431 \text{ ac-ft}$ $Q_p(\text{trial}) = \frac{277,450 (1 - \frac{1431}{2954})}{2954} = 193,050 \text{ cfs}$ $Y = 24.1'$

based on $Q_p(\text{trial})$ $V_2 = 912 \text{ ac-ft}$

$V_{\text{avg}} = 1172$

$Q_{p2} = \frac{277,450 (1 - \frac{1172}{2954})}{2954} = 167,370 \text{ cfs}$

Q_{p2} corresponds to a depth of 25.2' = El 1165.2'

Reach 5 (cont.)

Note that the WSEL at the bridge is 5-feet higher than at the confluence point, upstream. Reroute the flow through reach 4 assuming a WSEL at the confluence of Cleveland Brook and East Branch of Housatonic River of 1166.0.

Storage in reach 4 = 598 ac-ft

$$Q_{p2} = 305,000 \left(1 - \frac{598}{2954}\right) = 243,250 \text{ cfs}$$

Reroute reach 5

@ $Q = 243,250$ Stage = 1168.5 ft or $Y = 28.5'$

$V_1 = 1299 \text{ ac-ft}$ $Q_{p2}(\text{trial}) = 243,250 \left(1 - \frac{1299}{2954}\right) = 136,300$

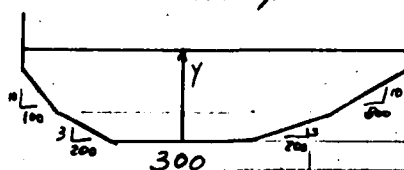
based on $Q_{p2}(\text{trial}) = 23.8$ $V_2 = 885 \text{ ac-ft}$

$V_{\text{avg}} = 1092 \text{ ac-ft}$

$$Q_{p2} = 243,250 \left(1 - \frac{1092}{2954}\right) = 153,300 \text{ cfs} \rightarrow Y = 24.5$$

WSEL = 1169.5'

REACH 6 Street upstream of Center Pond to section at mid-Center Pond.
Base WSEL on a trapezoidal X-section. Assume that flow is restricted to undeveloped overbank areas only.



Y, ft	Area, ft^2	Wetted Perimeter, ft	Q, cfs
23	29,000	1625	207,400
21	25,800	1620	171,300

Reach 6, (cont.)

Storage

WSEL, ft	Area, acres	Storage, ac-ft	Y, ft
1140	17.5	$17.5 \times 3 = 53$	3
1150	71	$53 + 44 \times 10 = 493$	13
1160	128.6	$493 + 100 \times 10 = 1493$	23

Route flow through reach 6

$$Q = 153,300 \text{ cfs} ; Y = 20.0 ; \text{Storage} = 1193 \text{ Ac-ft.}$$

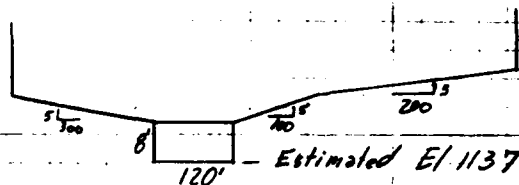
$$Q_{p2}(\text{trial}) = 153,300 \left(1 - \frac{1193}{2954}\right) = 91,400 \text{ cfs}$$

based on $Q_{p2} \text{ trial } Y = 16.6 ; \text{Storage} = 853 ; \text{Storage} = 1023 \text{ ac-ft}$

$$Q_{p2} = 153,300 \left(1 - \frac{1023}{2954}\right) = 100,200 \text{ cfs} ; \text{WSEL } 1159.1 \text{ ft.}$$

REACH 7: Mid of Center Pond to Main Street.

Assume section at Main Street to determine WSEL.



Rating Curve:

WSEL	Pressure Flow $C = 0.75$	Weir Flow $C = 2.8$	Total Flow, cfs
1150	12,900	8,100	21,000
1160	22,400	80,500	102,900

Reach 7 (cont.)

Storage

WSEL	Area, acres	Storage, acre-ft
1190	34	$34 \times 3 = 102$
1150	56	$102 + 95 \times 10 = 552$
1160	105	$552 + 80.5 \times 10 = 1357$

Reach 7 routing

$Q = 100,200 \text{ cfs}$; $WSEL = 1159.7$; $Storage = 1333 \text{ ac-ft}$.

$$Q_{P_2}(\text{trial}) = 100,200 \left(1 - \frac{1333}{2954}\right) = 55,000 \text{ cfs}$$

based on $Q_{P_2}(\text{trial})$ $WSEL = 1159.2$; $Storage = 890$ for $S_{h_{AVG}} = 1112 \text{ ft}$

$$Q_{P_2} = 100,200 \left(1 - \frac{1112}{2954}\right) = 62,500 \text{ cfs} ; WSEL = 1155.1 \text{ ft}$$

Note that $WSEL$ @ reach 7 is higher than @ reach 6.
Assume $WSEL$ of 1155.5 ft @ reach 6 and reroute
through reach 7.

@ $WSEL$ 1155.5 @ reach 6, the $Storage = 1043 \text{ ac-ft}$.
This is approximately equal to the computed average storage
for reach 6. Therefore the computed Q_{P_2} for reach 6
is O.K. and the reach 7 routing is also good
as computed above.

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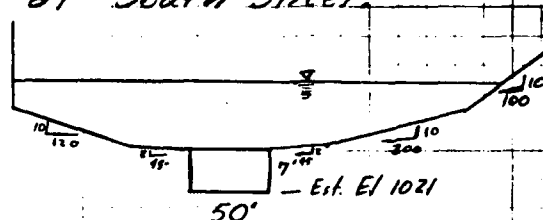
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REACH 8: Main Street to South Street

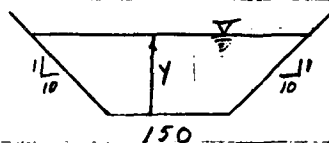
Estimate a cross-section @ South Street and determine the WSEL at South Street.



WSEL	Pressure Flow $C = 0.7$	Weir Flow $C = 2.8$	Total Flow, cfs
1040	6800	25,000	31,800
1045	8100	50,700	58,800
1050	9200	93,900	103,100

∴ WSEL to pass 62,500 cfs is 1045.4

Determine depth of flow at mid-reach. Assume a trapezoidal X-section



Avg. Slope ≈ 0.0075
 $n = 0.045$
Length of reach $\approx 7000'$

Y, ft	Area, ft ²	Q, cfs
10	2,500	26,600
15	4,500	59,900
20	7,000	109,400

∴ Average depth in the reach is 15.3 ft. The x-sectional area $\approx 5,200$ ft².

Reach 8 (cont.)

The slope in the reach is reasonably flat; some storage will accumulate in the reach.

$$@ Area_{avg} = 5,200 ft^2, Storage = \frac{5200 \times 7000}{43560} = 836 ac-ft.$$

$$Q_{p2}(trial) = 62,500 \left(1 - \frac{836}{2954}\right) = 49,800 cfs.$$

$$\text{based on } Q_{p2}(trial), Y = 12.7', Storage = \frac{3600 \times 7000}{43560} = 579 ac-ft.$$

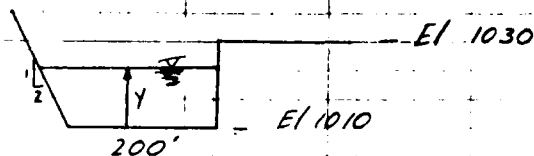
$$Avg Storage = 708 ac-ft.$$

$$Q_{p2} = 62,500 \left(1 - \frac{708}{2954}\right) = 47,500 cfs. \quad WSEL @ South St$$

Est. @ 1042.9

REACH 9: South Street to Dam just downstream of
Sewage Disposal Facilities.

Assumed Dam Profile:



WSEL	Dam Weir Flow (cfs); C = 3.3	Overbank Weir Flow (cfs); C = 2.8	Total Flow (cfs)
1010			0
1020	20,850	650	21,500
1025	38,350	1750	40,100
1030	59,050	3550	62,600

Storage

WSEL	Area, acres	Storage, ac-ft
1020	37	$37 \times 5 = 185$
1030	43	$185 + 40 \times 10 = 585$

Reach 9 (cont.)

route flow through reach 9:

to pass 47,500 cfs, WSEI @ Dam is 1026.6; Est. Storage = 41.

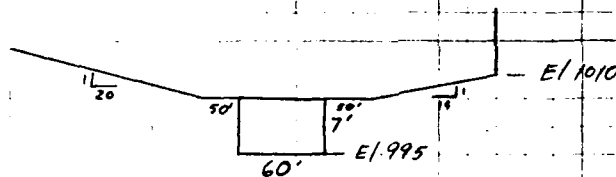
$$Q_{P_2}(\text{trial}) = 47,500 \left(1 - \frac{499}{2954}\right) = 40,300 \text{ cfs}$$

based on $Q_{P_2}(\text{trial})$, WSEI = 1025 and Storage = 385; $S_{\text{avg}} = 417 \times$

$$Q_{P_2} = 47,500 \left(1 - \frac{417}{2954}\right) = 40,800 \text{ cfs}; \text{WSEI } 1025.2$$

REACH 10: Dam to Hubbard Avenue. Length of reach is small, and storage for the reach is negligible. The reason for taking a section at Hubbard Avenue is to determine if the u/s dam is flooded and by how much.

Estimated X-Section at Hubbard Avenue:



WSEI	Pressure Flow $C = 0.7$	Weir Flow $C = 2.8$	Total Flow (cfs)
1010	6700	16,200	22,900
1015	8,500	39,700	48,200

backwater elev = 1013.5' ; WSEI @ Dam = 1025.2

$$\text{if } Q/Q_1 = \left(1 - \left(\frac{H_2}{H_1}\right)^{1.5}\right)^{0.385}$$

where: Q = free discharge
 Q_1 = reduced discharge
 H_2 = backwater height
 H_1 = water height @ Dam

$$Q/Q_1 = \left(1 - \left(\frac{3.5}{15.2}\right)^{1.5}\right)^{0.385} = 0.96$$

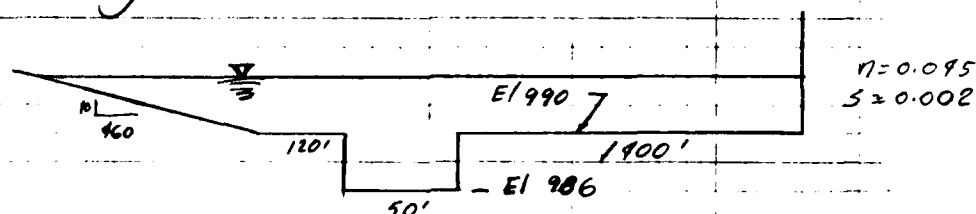
= percent of free discharge due to flooding of dam by backwater

reach 10 (cont.)

It appears that flooding of the dam reduces its efficiency by about 4 percent which can be neglected.

REACH 11: Hubbard Avenue to road embankment upstream of railroad bridge.

Compute WSEL based on a section through the roadway embankment.



Because most of the flow will be overbank flow, where the roadway blends with the surrounding topography, compute rating curve for the section based on open channel flow, rather than flow over a weir.

WSEL (ft)	X-Section Area (ft ²)	Wetted Perimeter (ft)	Flow (cfs)
995	8625	1813	36,100
997	12,317	1907	63,250

WSEL at road embankment is approx 995.4'

There is considerable storage in reach 11. A lot of this storage is along a tributary brook called Unkaniet Brook.

Storage	WSEL	Area, acres	Storage, ac-ft
	990	46.5	46.5 x 1.5 = 70
	1000	393.5	70 + 220 x 10 = 2270

Reach 11 (cont.)

route flow through reach 11

@ WSEL 995.4, Storage = 1258 ac-ft

$$Q_{p2}(\text{trial}) = 40,800 \left(1 - \frac{1258}{2959}\right) = 23,400 \text{ cfs}$$

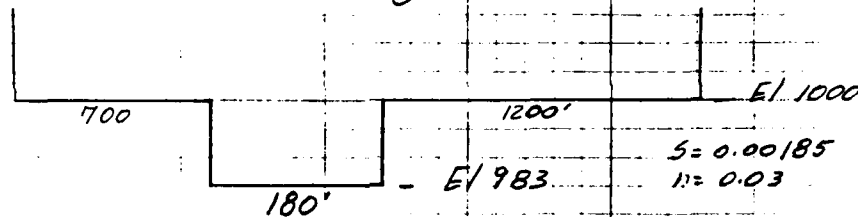
based on $Q_{p2}(\text{trial})$, WSEL = 999.1', Storage = 972 ac-ft

$$\text{Storage}_{\text{avg}} = 1115 \text{ ac-ft}$$

$$Q_{p2} = 40,800 \left(1 - \frac{1115}{2959}\right) = 25,400 \text{ cfs}; \text{WSEL} = 999.2'$$

REACH 12: Road embankment to railroad bridge

Estimated x-section through R.R. embankment.



WSEL. (ft)	Area (ft ²)	Wetted Perimeter (ft)	Flow (cfs)
990	1260	194	9,350
1000	3060	214	38,500

Storage	WSEL	Area, acres	Storage, ac-ft
	990	80	$80 \times 1.5 = 120$
	1000	208	$120 + 144 \times 10 = 1560$

reach 12 (cont.)

route flow through reach 12:

@ $Q = 25,400 \text{ cfs}$, $WSEI = 995.5 \text{ ft}$, $\text{Storage} = 912 \text{ ac-ft}$.

$$Q_{p2}(\text{trial}) = 25,400 \left(1 - \frac{912}{2954}\right) = 17,550 \text{ cfs}$$

based on $Q_{p2}(\text{trial})$, $WSEI = 992.8 \text{ ft}$; $\text{Sto} = 523$ for $\text{Sto}_{H_6} = 718$

$$Q_{p2} = 25,400 \left(1 - \frac{718}{2954}\right) = 19,250 \text{ cfs}; WSEI = 993.4' \text{ @ Bridge}$$

Determine $WSEI$ just upstream of the bridge:

contraction loss:

$$h_c = 0.5 \left(\frac{V_1^2}{2g} - \frac{V_2^2}{2g} \right) \text{ for sharp cornered entrance}$$

$$\text{Velocity upstream, } V_2 \approx \frac{Q}{700 \times 10.5} = \frac{Q}{7350 \text{ ft}^2} = 2.6 \text{ fps}$$

$$\text{Vel downstream, } V_1 = 19,250 / 1875 = 10.3 \text{ fps}$$

$$h_c = 0.5 \left(\frac{10.3^2}{64.4} - \frac{2.6^2}{64.4} \right) \approx 0.8 \text{ ft}$$

$\therefore WSEI$ just upstream of the bridge $\approx 994.2 \text{ ft}$.

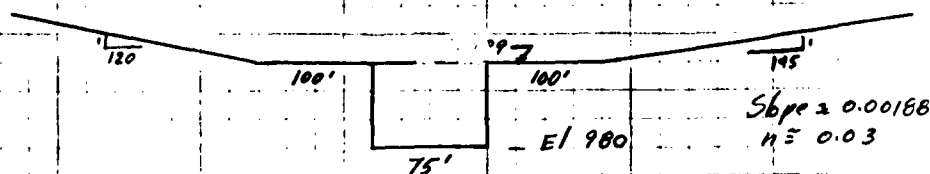
and storage for the reach $\approx 725 \text{ ac-ft}$

$$\therefore \text{corrected outflow} = 25,400 \left(1 - \frac{725 + 718}{2954}\right) = 19,200 \text{ cfs}$$

REACH 13: Railroad Bridge to bridge at East Street

Assume a control section at the East Street bridge.

Estimated X-Section:



reach 13 (cont.)

WSEL (ft)	Orifice Flow, cfs $C=0.7$	Weir Flow, cfs $C=2.8$	Total Flow
989	5,450	—	5,450
993	10,400	10,100	20,500

Storage:

WSEL	Area, acres	Storage, ac-ft
990	14	$14 \times 1.5 = 21$
1000	32	$21 + 23 \times 10 = 251$

Route flow through reach 13:

@ $Q = 19,200$ cfs ; WSEL ≈ 992.7 and Storage ≈ 83 ac-ft

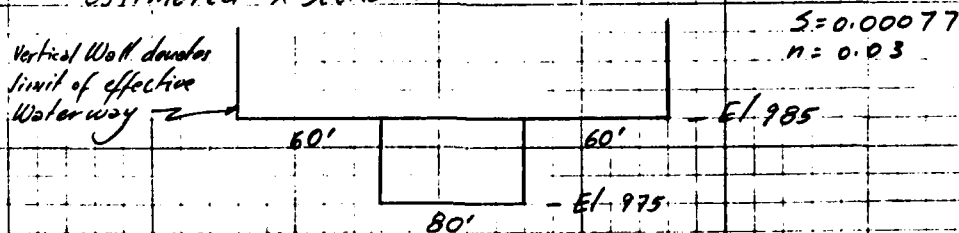
Since storage is small, no iterations are required.

$$Q_{p2} = 19,200 \left(1 - \frac{83}{2954}\right) = 18,650 \text{ cfs ; WSEL } 992.5$$

REACH 14: East Street to Newell Street

Assume the Newell St. Bridge to be the control section:

Estimated X-Section:



WSEL	Orifice Flow, cfs $C=0.7$	Weir Flow, cfs $C=2.8$	Total Flow, cfs
985	4,400	—	4,400
900	11,900	6,250	18,150

reach 14 (cont.)

Storage:

WSEL	Area, acres	Storage, ac-ft
980	31	$31 \times 2.5 = 78$
990	660	$78 + 345.5 \times 10 = 3533$

reach 14 provides considerable storage. Instead of taking a section at mid-reach to maintain the storage for the reach below 50% of the reservoir storage, use the following approach.

Assume a flow @ Newell Street of 7000 cfs.

WSEL @ Newell St. ≈ 986.0 ft; assume a WSEL of 986.5 @ mid-reach.

Average Storage for the total reach ≈ 2324 ac-ft
At mid-reach, the storage ≈ 1162 ac-ft

$$Q_{p2} @ \text{mid reach} = 18,650 \left(1 - \frac{1162}{2954}\right) = 11,300 \text{ cfs}$$

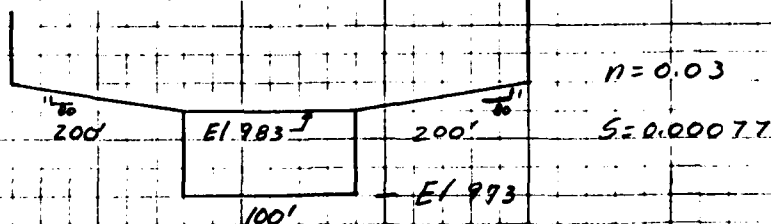
$$Q_{p2} @ \text{Newell St} = 11,330 \left(1 - \frac{1162}{2954}\right) = 6,850 \text{ cfs}$$

resulting WSEL @ the bridge ≈ 985.9 ft ≈ 986.0 o.k.

REACH 15: Newell Street to bridge at unnamed downstream street between East & Newell Street.

Assume that the bridge at the unnamed street controls.

Estimated X-section.



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WSEL	Orifice Flow, cfs $C=0.7$	Weir Flow, cfs $C=2.8$	Total Flow, cfs
983	5,650	—	5,650
988	12,550	11,250	23,800

Storage	WSEL	Area, acrs	Storage, acre-ft
	980	16	$16 \times 6 = 96$
	985	42	$96 + 29 \times 10 = 386$

@ $Q = 6,850$ cfs, $WSEL \approx 983.3'$ and $Storage = 192$ ac-ft.

$$Q_{p2}(\text{trial}) = 6,850 \left(1 - \frac{192}{2954}\right) = 6,400 \text{ cfs}$$

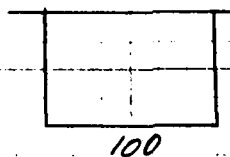
based on $Q_{p2}(\text{trial})$, $Storage = 189$ for an avg. of 191 ac-ft.

$$Q_{p2} = 6,850 \left(1 - \frac{191}{2954}\right) = 6,400 \text{ cfs}; WSEL 982.2'$$

REACH 16: Unnamed Street to Elm Street.

Assume X-section at Elm Street bridge to be the control section

Estimated X-section:



El 983.5

$n = 0.03$
 $S = 0.00077$

El 971.5

WSEL	Flow, cfs (based on Manning's Open Channel Eq.)
981.5	5650
983.5	7500

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reach 16 (cont.)

Storage:

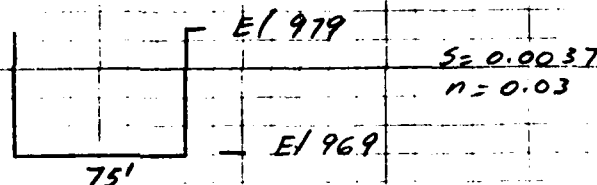
WSEL	Area, acres	Storage, ac-ft.
180	18	$18 \times 8 = 144$
185	39	$144 + 28.5 \times 10 = 429$

@ $Q = 6,400$ cfs, WSEL $\approx 982.3'$; Storage ≈ 210 ac-ft.
since storage is minor, no iterations are necessary.

$$Q_R = 6,400 \left(1 - \frac{210}{2954} \right) = 5,950 \text{ cfs.}; \text{WSEL } 981.8'$$

REACH 17: Elm Street to Dawes Avenue

Estimated X-Section at Dawes Avenue:



There is no material storage in reach 17.

WSEL	Flow
977	6350
979	9000

$$@ Q = 5,950 \text{ cfs} \quad \text{WSEL} \approx 976.7 \text{ ft. @ Dawes Av.}$$

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REACH 18 Doves Ave. to Pomeroy Avenue crossing
with the East Branch of the Housitonic River.

Assume a cross section at Pomeroy Avenue similar
to that at Doves Avenue.

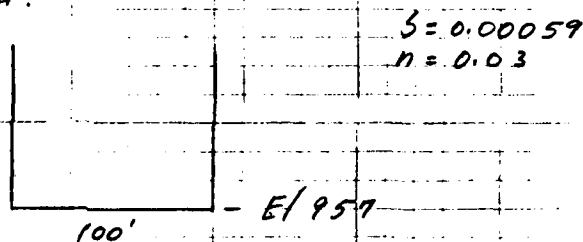
therefore, if bottom channel elevation is 963 ft, the
WSEI at Pomeroy Ave is 970.7

at this WSEI, Storage is approx. $\frac{400\text{ft} \times 1400\text{ft} \times 4\text{ft}}{2 \times 3560} = 52 \times 4$

$$Q_{P_1} = 5950 \left(1 - \frac{52}{2954}\right) = 5,850 \text{ cfs. ; WSEI } 970.4'$$

REACH 19: Pomeroy Ave @ East Br. of Housitonic to Pomeroy
Ave. @ Housitonic River.

Estimated X-Section:



WSEI	Flow, cfs
967	4950
970	7450

Storage:

WSEI	Area, acres	Storage, cu-ft
960	28	$28 \times 1.5 = 42$
970		$42 + 90 \times 10 = 942$

reach 19 (cont.)

@ $Q = 5,850$ cfs, $WSEL = 968.1$, $Storage = 771$ ac-ft.

$$Q_p(\text{trial}) = 5850 \left(1 - \frac{771}{2959}\right) = 4,323 \text{ cfs}$$

based on Q_p trial, $WSEL = 966.2$, $Sto = 600$ ac-ft.

$$Sto_{\text{avg}} = 686 \text{ ac-ft}$$

$$Q_p = 5850 \left(1 - \frac{686}{2959}\right) = 4,500 \text{ cfs.}$$

$$WSEL = 966.5 \text{ ft.}$$

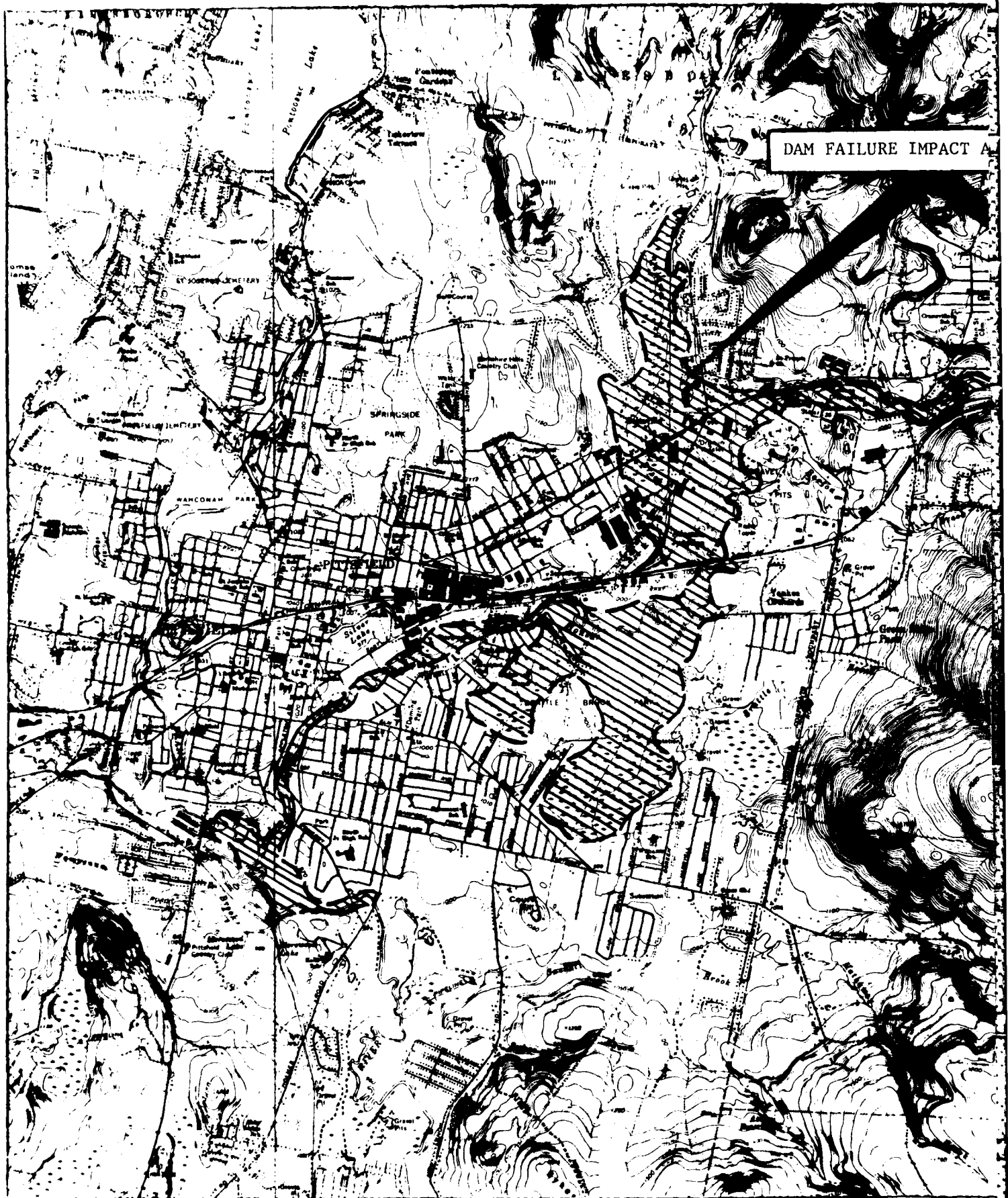
REACH 20: Pomeroy Ave. at Housitonic River to
Holmes Road.

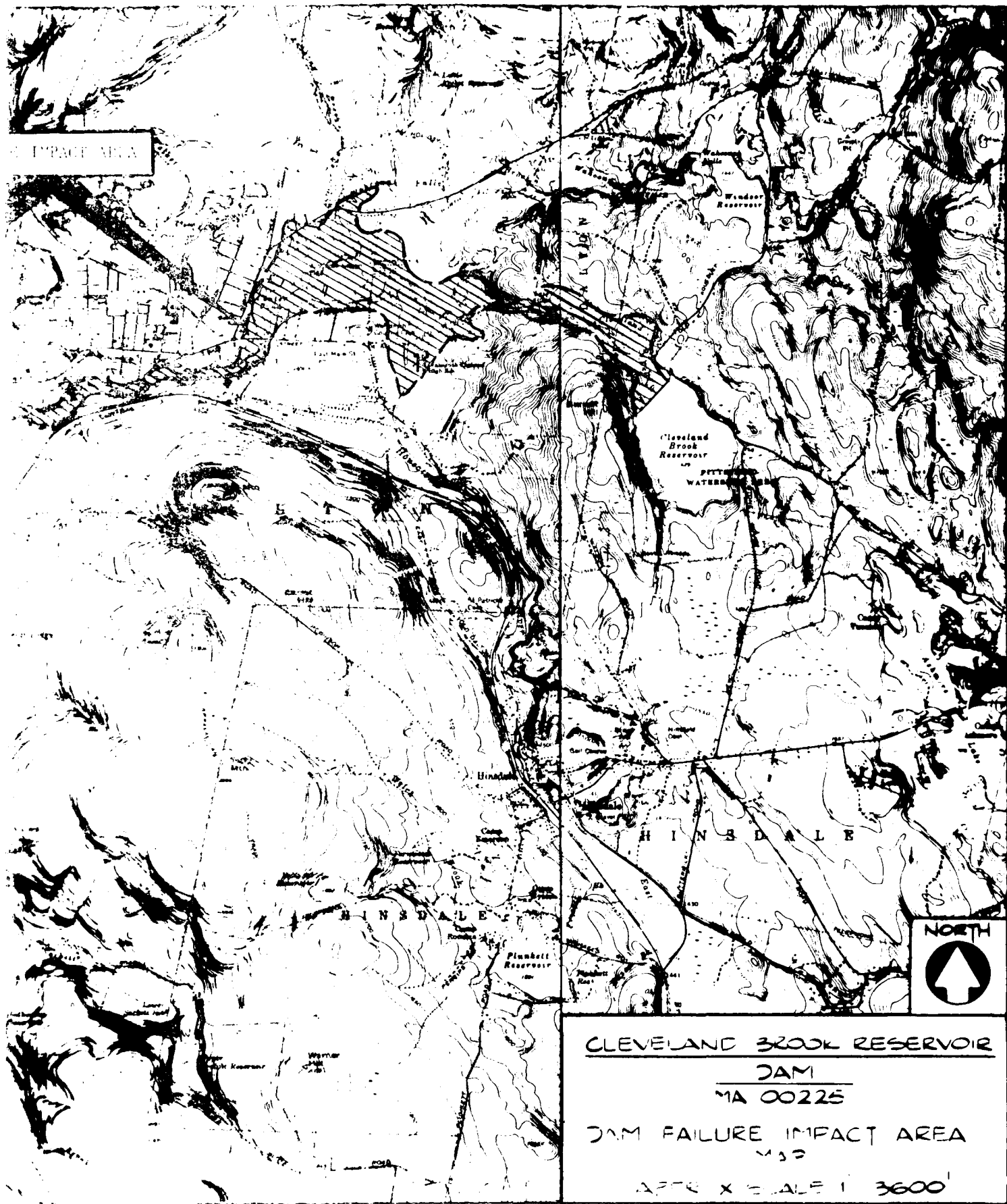
Assume the bridge at Holmes Road to have a capacity similar to that at Pomeroy Ave. The channel invert at Holmes Road is about the same elevation as at Pomeroy Ave. Therefore the

$WSEL @ \text{Holmes Road} \approx 966.5$

Beyond Holmes Road the overbank storage is extensive the remaining flow will be attenuated and no further potential for loss of life or property is expected.

From the Cleveland Reservoir up to Holmes Road the potential for loss of life and property is **HIGH**





2

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS



INVENTORY OF DAMS IN THE UNITED STATES

STATE	DIVISION	CONGR. DIST.	STATE	COUNTY	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE
MA	225	NED	MA	003	CLEVELAND BROOK RESERVOIR DAM	4228.2	7306.9	31 MAY 79

POPULAR NAME	NAME OF IMPONDMENT
CLEVELAND BROOK	CLEVELAND BROOK RESERVOIR
REGION BASIN	RIVER OR STREAM
01 07	DALTON
NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	POPULATION
	7500

TYPE OF DAM	YEAR COMPLETED	PURPOSES	HYDRAULIC HEIGHT (FT.)	IMPONDING CAPACITIES (ACRES-FT.)	DIST. OWN	FED R	PRV/FED	SCS A	VER/DATE
HEPG	1948	S	71	70	6022	4928	NED	N	N

REMARKS

D/S HAS	SPILLWAY	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY (MW)	NAVIGATION LOCKS
1	1650 U 80	4450			

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF PITTSFIELD	METCALF + EDDY ENGINEERS	

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE	AUTHORITY FOR INSPECTION
CAMP DRESSER + MCKEE INC	01 MAY 79	PUBLIC LAW 92-367

REMARKS

END

FILMED

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